THE HEALTH SERIES

OF

PHYSIOLOGY AND HYGIENE

MAKING THE MOST OF LIFE

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HEALTH HABITS

HEALTH AND CLEANLINESS

THE BODY IN HEALTH

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MAKING THE MOST OF LIFE

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INTRODUCTION

It is the aim in "The Health Series of Physiology and Hygiene" to present in an attractive form for pupils in the elementary school the latest and most accurate knowledge relating to physiology, and especially to the hygiene of daily life. The constant effort of the authors has been to make scientific knowledge so simple, so concrete, and so captivating that pupils can hardly fail to take an interest in the problems of preserving health for the purpose of making the most of life.

Throughout the series, the aim has been kept in view of awakening in the young a normal desire to live in such a manner as to develop strength and preserve health, because in this way the individual will have the greatest success in securing the things which he desires, and in avoiding the disabilities and pains which otherwise are likely to occupy a considerable part of his life. Comparatively little attention is given to anatomy, and only sufficient physiology is presented to constitute a basis for the facts of health which are discussed.

Very extensive use is made of photographs and diagrams illustrating every-day life in the city and in the country. There is at least one interesting and practical original exercise suggested for every principle of health presented

in any lesson, and it is the plan that each pupil should work out each exercise and report upon it during the recitation period. In order further to assist the teacher and the pupil, a list of questions, fully covering the text, has been given at the end of each chapter.

PREFACE

There is one word which has come to be used very freely by every one to-day — "Efficiency." Men in all walks of life are studying the question of avoiding waste and making their efforts count for more than they did formerly. Suppose a manufacturer has been in business for thirty or forty years; if he should conduct the business to-day just as he did when he started it, he would probably soon have to abandon it altogether, because he could not compete with his rivals who had adopted more efficient methods. Now, the human body is a kind of manufacturing concern, only it is a more complicated one than any establishment that man can build. Just because it has so many parts and is capable of performing such a variety of acts, there is likely to be a good deal of waste, and it may not be able to produce the right kind and amount of results in work or in pleasure. So the chief thing for any person to do is to study the question of making his body a smooth-running and effective working machine, so that it will always be ready for any task or enterprise. Only in this way may the most be got out of life.

This last book in the Health Series shows the relation between health and efficiency and discusses all the problems that have to be considered in maintaining bodily vigor,

poise, and resistance to disease and fatigue. The conditions of living are not the same to-day as they were one hundred years ago; and if a person desires to get the most out of life, he must adapt his habits to the changed conditions. If his habits are just the same as those of his great-great-grandfather, he will be likely to be handicapped in practically all that he wants to do. When he ought to feel fine and ready for any task, he may be suffering from aches and pains and not have energy enough for the demands that are made upon him. Then, too, one must have good appearance in these times when he has to deal with so many people. If he has an ill-formed or badly developed body, it will count against him wherever he goes. Further, if he imitates some of the people around him who are constantly putting into the body things which weaken it and lower its efficiency, it will be impossible for him to get out of life what nature intended he should. All these matters are presented in a concrete way in this book.

A great many photographs and drawings have been made for this book in order to impress health principles. Every topic discussed is indicated in a topical heading in the margin; original exercises designed to apply each principle are given, and review questions covering each point touched upon are added to each chapter. The book is completed with a glossary and an index which will save the time of both teacher and pupil in looking up any word or subject.

CONTENTS

MAKING THE MOST OF LIFE

CHAPTER I

TAKING THE MEASURE OF A MAN

In taking the measure of a man we will begin with the tape measure. The height varies very greatly. The average height for man is *68 inches* while the average for woman is *64 inches*. Great height is in some cases due to extraordinary length of legs. For this reason the sitting height is more important than the standing height as a measure of body development. Women as a rule have shorter legs than men, and so approach nearer the male average in sitting than in standing height.

The average height.

A prehistoric cemetery discovered in Southern France contained bones whose proportions indicated that they must have belonged to men at least eight feet high. The average height of human beings to-day is doubtless less than it was in some former age.

That the average height is decreasing is shown in the fact that the minimum height required for enrollment in the army has of late been considerably lessened

in different countries. France has lowered the standard three times in fifty years, making a total difference of four inches. The English government has been obliged to lower the standard as much as six inches in fifty years, and the United States Government has also recently lowered its standard.

That there is some advantage in height may be shown in the fact that we all wish to be tall. A person of tall stature has (other things being equal) a more commanding presence and greater physical power. Low stature is often a handicap in the race of life. Nevertheless, some of the world's greatest men in all lines have been men of small stature. Alexander the Great, Napoleon, Lord Nelson, Lord Roberts, and many more of the great military geniuses of the world were men of small or medium stature. It may be that the advantage is not all on the side of the tall man. Energy, alertness, and quickness of thought and action are more frequently the qualities of the small man than of the man of great stature.

Taking the measure of a man.

That systematic physical exercise tends to increase the height is shown in the fact that young men who enlist in the army sometimes increase several inches in height as a result of the military drill. An English trainer reports the case of a young man twenty-one years of age who had not grown perceptibly for two years, but who took a new start and grew four inches as the result of systematic exercise after entering military service.

Exercise and Height.

The height depends primarily upon the length of the bones. The bones are nourished by the arteries supplying the overlying muscles. We know that the blood supply of an active muscle is several times as great as that of an inactive one. (Illustrate this by an experiment.) The growth of the bones depends much upon muscular activity and is likely to be increased by vigorous exercise. The time to work for an increase in height is while the growing bones still contain more or less cartilage. Why? After the bones become hardened, not much change can be made in the height. When do they become hardened?

During the years of growth there should be a steady increase in height, though the rate of growth varies at different ages, and in this respect there is a difference between boys and girls. Measurements made of a great many thousands of children in different countries show that the average height of boys and girls is almost the same until about the eleventh year, when the girls become taller and keep ahead up to about the sixteenth

year. Then the boys not only catch up with the girls, but even surpass them in height.

SYMMETRY IS OF GREATER IMPORTANCE THAN HEIGHT.

Symmetrical development.

Of more importance than height is symmetry, which means a good general development of the whole body. According to Dr. Giovanni, of Milan, the proper proportions of the human figure are as given in the accompanying table. You may use the tape line on yourself to see how nearly you approach his standard of the ideal proportions. In this way you may find out what are your deficiencies and what parts of your body need special development.

1. The height of a person is equal to the greatest stretch of the arms; that is, the distance between the tips of the middle fingers when they are extended laterally as far as possible.
2. The circumference of the chest is equal to one half the height.
3. The length of the sternum or breast bone is equal to one fifth of the circumference of the chest.

Represented in inches, these measurements work out as follows for a man and woman who closely approach the ideal type, although a particular man or woman might vary considerably from these measurements, and still be normal:

	Man	Woman
Height	68.8 inches	64 inches
Extreme stretch of arms	68.8 inches	64 inches
Circumference of chest	34.5 inches	31.8 inches
Length of sternum	6.8 inches	6.4 inches
Height of abdomen	12.9 inches	12 inches
Width of pelvis	10.4 inches	10.1 inches

The waist of the ideal woman is a little larger in proportion to her height than that of the ideal man. According to the famous Venus de Milo, a woman's waist measurements should be 47.6 per cent of the height. In women, the organs which lie in the waist zone, — the liver, stomach, kidneys, spleen, and pancreas, — are normally larger in proportion to the body weight than they are in men. This is necessary on account of the function of motherhood, when these organs have to do work for two. A very small waist is an evidence of weakness and usually means internal deformities.

A small person who is well proportioned and well-poised has a much better appearance and makes a better impression than a tall person who is not well developed and has not a good carriage.

Good poise more important than stature.

Here is a test you may make as to the habitual attitude of your body: A plumb line dropped from the tip of your nose should fall one inch in front of your big toes. Your shoulders and hips should touch a straight vertical line. If you fail to come up to this standard, take a look

at yourself sideways in the glass. It is quite certain *that you are round-shouldered, your chest caves* in, and your abdomen sticks out. You need to practice exercises for obtaining the correct standing and sitting positions until they become habitual.

It is very important to remember that the position habitually taken in standing or sitting is a mold into which the body grows. A person who sits in a drooping attitude becomes round-shouldered and flat-chested. You know what happens to the internal organs of such a person. The lungs have not space for proper development, and the depression of the ribs crowds down the stomach, liver, and other abdominal organs, which are not sufficiently supported by the relaxed and weakened abdominal muscles. The breathing is inefficient, the circulation is interfered with, the vital organs become congested with stagnant blood, and various disorders are likely to result.

TRY THIS TEST ON YOURSELF.

The beauty of the body.

While we are speaking of symmetry, we may notice something which is closely associated with it,— beauty. This is one of the characteristics of a well-proportioned, healthy human being.

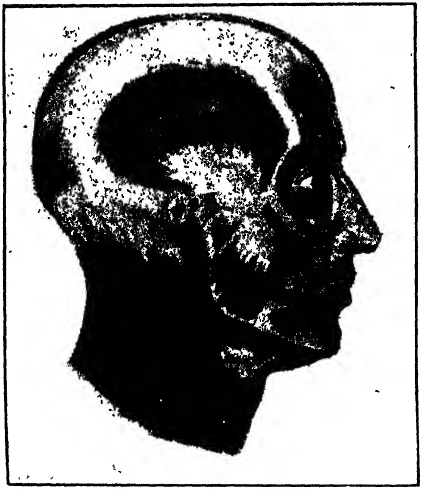
Human beauty consists in regularity of features, clearness of skin, intelligence of expression, symmetry of form, and grace of motion. Beauty is more than skin deep. Beauty without is born of health within. A beautiful skin, without pimples or discolorations or eruptions of any kind, depends upon a healthy condition of the blood. A skin fed by healthy blood has a fineness of texture, a clearness and cleanness of tint, and a glow of life, that are always pleasing.

Beauty of form depends very much upon the development of the muscles.

In the ideal form, the layer of fat beneath the skin is just sufficient to round out the corners and pad out the form and features, leaving no unsightly hollows or disfiguring lumps of superfluous tissue.

If the skin were removed, it would be seen that nearly all the surface of the body is composed of muscles. It is readily seen that beauty of form, as well as grace of motions, depends very much upon the proper development of the muscles. Even the regularity of the features depends to a great degree on the rounded and perfect outline of the muscles of the face. And the expres-

sion of the face depends upon the sort of muscles that are brought oftenest into action. Those that contract oftenest become the strongest, and give the index to the face, making it grave or gay, smiling or frowning, pleasant or morose. These muscles are attached to the skin, and they pull the skin around in different ways to make it conform to the varying states of the mind. So the face is a mirror of the mind, and a beautiful expression is not possible without good, pure, and beautiful thoughts.



THE BEAUTY OF THE FACE DEPENDS VERY LARGELY UPON THE MUSCLES THAT ARE HABITUALLY MOST ACTIVE.

The weight of the body.

In measuring our man we shall next use the scales or weighing machine. The weight of man varies far more than the height, on which, of course, it largely depends.

History tells us of a Mr. Lambert, of Leicester, England, who "in corporeal greatness had no competitor, having reached the enormous weight of 628 pounds." Think how heavily handicapped one would be with such a load to carry!

It has been estimated that a perfectly proportioned man weighs from two to two and a half pounds for each inch of his height.

The following table gives us the average weight for boys and girls of different ages and heights.

Age	Boys		Girls	
	Height in inches	Weight in lbs.	Height in inches	Weight in lbs.
5	41.57	41.09	41.29	39.66
6	43.75	45.17	43.35	43.28
7	45.74	49.07	45.52	47.46
8	47.76	53.92	47.58	52.04
9	49.69	59.23	49.37	57.07
10	51.58	65.30	51.34	62.35
11	53.33	70.18	53.42	68.84
12	55.11	76.92	55.88	78.31
13	57.21	84.85		
14	59.88	94.91		

Weigh and measure yourself and your classmates to see how closely you all come to these averages. One's nationality determines to some extent his height and to a less extent his weight. See if you can tell from observing the people in your community whether American men and women are taller or shorter, heavier or lighter, than people who have recently come from Germany or Italy or Ireland or Sweden or England or Russia, and so on.

The following table shows the relation of height and weight at different ages.

Table of Relation of Height and Weight Compiled from *Life Insurance Records*

Men — Ages 15 to 24		Women — Ages 15 to 19	
Height	Weight	Height	Weight
5 feet 0 inch	120	4 feet 11 inches	111
1 inch	122	5 feet 0 inch	113
2 inches	124	1 inch	115
3 inches	127	2 inches	117
4 inches	131	3 inches	120
5 inches	134	4 inches	123
6 inches	138	5 inches	125
7 inches	142	6 inches	128
8 inches	146	7 inches	132
9 inches	150	8 inches	136
10 inches	154	9 inches	140
11 inches	159	10 inches	144
6 feet 0 inch	165		
1 inch	170		
2 inches	176		
3 inches	181		

The weight, like the height, should steadily increase during the years of growth. These tables show us that even after adult life is reached, there is usually some increase of weight with advancing years.

The chief medical director of one of the largest life insurance companies of New York said that, in collecting statistics of weight, the average weight had been taken as the normal standard, so that it seemed natural for people to grow more stout as they grew older. But when he came to study the death rate, he found that

the average mortality was lowest among those a little below the average weight. This indicates that the average weight is not the normal weight, and that though the average weight increases with years the normal weight does not. That is, for a man of a certain height there is a fixed normal weight close to which he should keep through life.

In a healthy person there are usually slight changes from time to time in the weight, but any considerable deviation from the normal should be given attention. A rapid loss in weight may indicate the development of tuberculosis or disease of some internal organ. Fever causes a rapid loss in weight, as does also any disease which interferes with the digestion or assimilation of food.

Athletes or others in special training to reduce their weight may acquire a very rapid loss without injury. Jockeys sometimes lose more than twenty pounds in a week.

Loss of sleep will invariably cause loss of weight. Stock raisers know that it is no use to try to fatten an animal that becomes restless and will not sleep. A baby that sleeps most of the time, as a normal infant should do, is usually plump, while a restless, crying baby is always puny. So a sufficient amount of sleep is of great importance during the growing period to keep one up to the normal standard of weight.

On the other hand, a rapid gain in weight above the normal also calls for attention. The statistics of

insurance companies show that persons who are ten per cent over weight are on the average shorter lived than those who are ten per cent under weight. Very fleshy persons are seldom long lived. When a sheep becomes very fat the butcher knows it must be killed or it will decline and die. The fat is likely to accumulate not only beneath the skin upon the outside of the body, but also upon the inside about the internal organs. Then the vital machinery becomes clogged, and the action of the lungs, heart, and other organs is interfered with. This naturally has the effect of lessening the mental energy. That this handicap may be overcome, however, is shown by the fact that some of the most eminent statesmen have been men of great bulk.

The evil of too much flesh.

It is not the amount but the quality of one's flesh that counts. Exercise hardens the muscles, and gives firmness and solidity to the body, increasing its specific gravity. (What does this mean?) Athletes and others who are physically active weigh more in proportion to their size than those whose flesh is soft and flabby from lack of exercise. Why, do you think?

In ancient Sparta, whose people were a race of warriors, the State required of every citizen a high standard of physical efficiency. Among them corpulence was treated as a crime. The citizen who grew too fat or too soft for military exercise was punished by whipping. One offender was brought before the council at a meeting of the people of Sparta, and his illegal fatness was

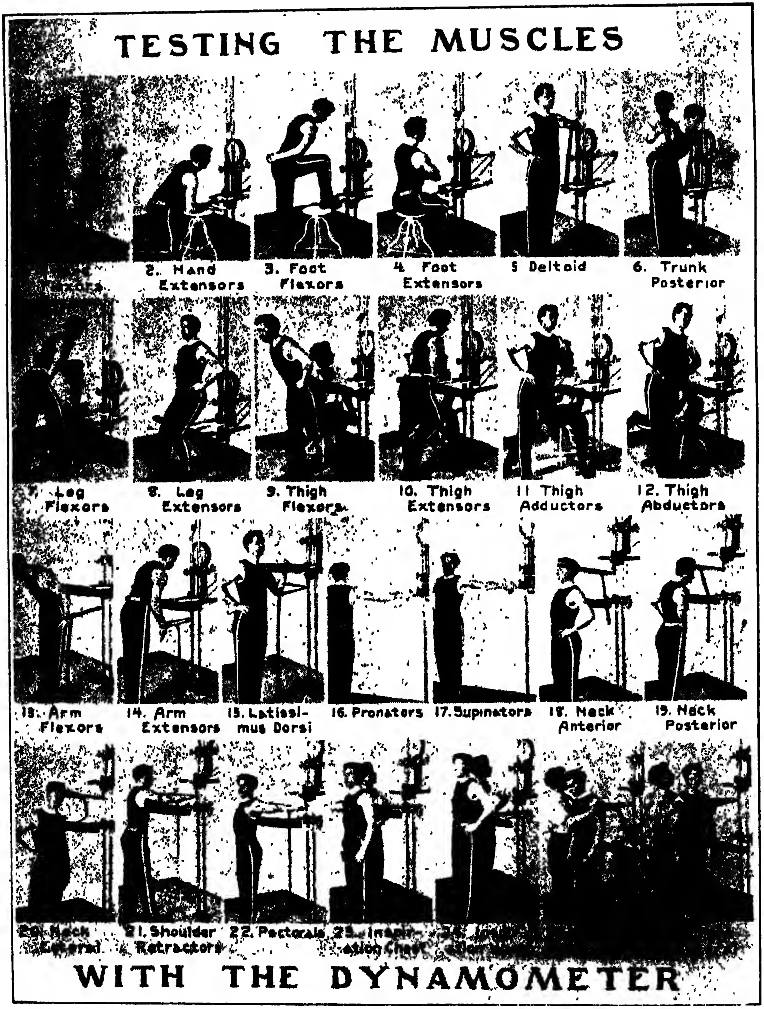
publicly exposed. He was then threatened with perpetual banishment if he did not reduce his proportions to the Spartan standard. Was this a good plan to follow? Why?

The strength of man.

The tape measure and the weighing machine do not, after all, tell us very much about the man; they do not even tell us whether he is alive or dead. Here is another measuring instrument — the dynamometer — which will give us an accurate description of the living, active man. By it we are able to measure the energy of the body and the ability to manifest that energy through the muscular system as a whole, or through each particular group of muscles. It tests the strength of the hand grip, the arm pull, the trunk pull, and so on (about twenty-five groups in all) unassisted by any of the other muscles.

Since the muscular system is actuated and controlled by the nervous system, the dynamometer tests not only the muscles but the nerves and nerve centers as well, and so gives us a precise measure of the condition of a man's motor apparatus, or his ability to exert power. For this purpose it is used in the United States government military training schools and in the university and other gymnasiums, to find out the strength capacity, to bring to light any weakness in special groups of muscles, and so to indicate the kind and amount of exercise needed to bring the individual to a normal state.

From an examination of two hundred healthy young


TESTING THE MUSCLES
2. Hand Extensors
3. Foot Flexors
4. Foot Extensors
5 Deltoid
6. Trunk Posterior
Leg Flexors
8. Leg Extensors
9. Thigh Flexors
10. Thigh Extensors
11 Thigh Adductors
12. Thigh Abductors
Arm Flexors
14. Arm Extensors
15. Latissi-mus Dorsi
16. Pronators
17. Supinators
18. Neck Anterior
19. Neck Posterior
21. Shoulder Retractors
22. Pectorals
WITH THE DYNAMOMETER

men between the ages of twenty to thirty and an equal number of healthy young women of the same age, the following table showing their comparative strength expressed in pounds avoirdupois has been made.

What one's strength should be.

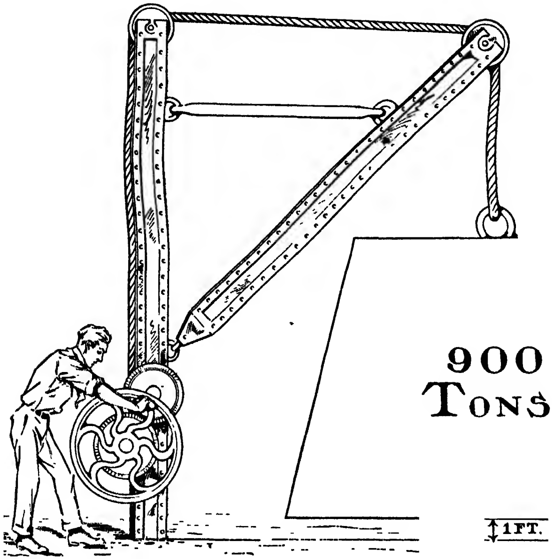
	MEN	WOMEN
Strength of arms	1530 pounds	865 pounds
Strength of legs	2265 pounds	1325 pounds
Strength of trunk	1040 pounds	515 pounds
Strength of chest	365 pounds	165 pounds
Strength of entire body . . .	5200 pounds	2870 pounds

From a study of these tables we may learn some interesting facts. The total strength of the average woman as compared with that of the average man is .55, or a little more than half. The weight of the average woman as compared with that of the average man is .86, or about four fifths. The height of the average woman as compared with that of the average man is .94. It thus appears that the average woman is even more inferior to the average man in strength than she is in height and weight.

In a comparative study of tall men and short men, it has been found that tall men are at nearly every point stronger than short men. The total strength capacity of the short man was found to be ninety per cent of that of the tall man.

The total strength capacity of the muscles in a well-

developed man is about 10,000 foot pounds, that is, the ability to lift 10,000 pounds one foot high. This represents, of course, not the weight that the man could actually lift, but the aggregate strength of all the muscles of the body.



THIS SHOWS THE TOTAL AMOUNT OF WORK THAT MAY BE DONE IN ONE DAY BY A LABORING MAN.

The total amount of work that may be done in a day by an ordinary laboring man is estimated by competent authorities to be about equal to 1,800,000 foot pounds, or the lifting of nine hundred tons one foot high. This is equivalent to the lifting of a hundred pound weight one foot high, thirty times a minute during ten hours.

A man could not, of course, accomplish this with his arms alone, but by employing both his arms and his legs he may accomplish this enormous amount and even more. Indeed, the body has such a wonderful capacity for work that it is possible for a strong man to put forth this amount of effort in a fraction of a day by taxing his energies to the utmost, as in such violent exercise as a rowing or swimming contest.

Health Problems

1. Find out whether the leading men in your community are above the average in height or below it.

2. If you can do so, find out whether the tall men in your community belong to some particular profession.

3. Have the presidents of the United States been above the average height, or have they been below it?

4. Are there some kinds of work which can be done by short as well as by tall men? If you think so, mention the kinds of work you have in mind.

5. Is it as necessary that men should be tall to-day as it was thousands of years ago, when they worked with the muscles mainly, and when there were no railroads, telephones, automobiles, or such inventions?

6. How many of the people you meet seem to you to be symmetrical and well poised? What is the trouble with those who are not so?

7. What is the chief reason why people become unsymmetrical, do you think?

8. Which would you rather be, if you could not be exactly normal — too lean or too fleshy? Why?

9. Do you know many people who are too fleshy? What habits of living make them so?

10. Are the people in your community who are "doing things" lean people, or are they fat?

11. Show by taking some object in the room what a foot pound means.

12. How much work would you do in one minute if you should lift a classmate weighing fifty pounds three feet high twelve times in the minute?

13. Try to calculate in foot pounds how much work you would do in one day if you should walk fifteen miles on a level road.

Review Questions

1. What is the height of the average man? Of the average woman?

2. Why is sitting height more important than standing height?

3. Is the average height of men and women increasing or decreasing?

4. Are the greatest men as a rule the tallest men? Can you name a great man who is quite short?

5. How may height be increased? At what time in life does a person increase the most in height? Why?

6. What is meant by *symmetry?* Why is symmetry more important than weight?

7. According to Doctor Giovanni, what are the ideal proportions for the human body?

8. What habits of sitting and standing may spoil the symmetry of the body?

9. Describe a beautiful person.

10. What does a rapid loss in weight often indicate?

11. Is a rapid gain in weight a good thing?

12. Which live the longer, usually — lean people or very fleshy people?

13. How were people who were too fleshy treated in Sparta?

14. What is a dynamometer? Describe its use.

15. How does the average woman compare with the average man in height? In strength? In weight?

16. What is meant by a foot pound? The work done by the average laboring man in one day is equal to how many foot pounds?

CHAPTER II

The Vital Machinery

As you probably know already, a great amount of work is done by the heart. The work done by the right ventricle, which sends the blood into the lungs, or the pulmonary circulation, is only one third that of the left ventricle, which drives the blood through the general circulation. One physiologist has calculated that the work done by the two ventricles in twenty-four hours "is enough to raise a weight of half a stone (seven pounds) from the bottom of the lowest mine to the top of the highest mountain, or to raise the man himself to more than twice the height of the spire of Strasbourg Cathedral," which is a distance of about one thousand feet.

The work of the heart.

When the heart contracts, a wavelike impulse is sent throughout the whole system, traveling from the heart to the remotest part of the system in the sixth part of a second, so that it is practically instantaneous. Where the arteries come close to the surface, this movement (the pulse) may be felt. The frequency of the pulse depends upon the age. The following table gives the average rate for different ages.

At birth	. . . .	*136 beats per minute*
From 2–7 years	. . .	97 beats per minute
From 14–21 years	. . .	76 beats per minute
From 28–35 years	. . .	70 beats per minute
From 56–63 years	. . .	68 beats per minute
From 77–84 years	. . .	71 beats per minute

In women the pulse is seven to ten beats faster than in men. The average rate of pulsation in men is 72, in women 80.

The rate at which the heart works varies with many conditions. When one is lying in bed, the heart has only to move the blood on a level; but when one is sitting, standing, or walking, the heart has to lift the blood in the body to a greater or less height and so has a much larger amount of work to do than when one is lying down. In exercise, the rate of the heart beat is greatly increased, as you know; and there are other factors which modify its action.

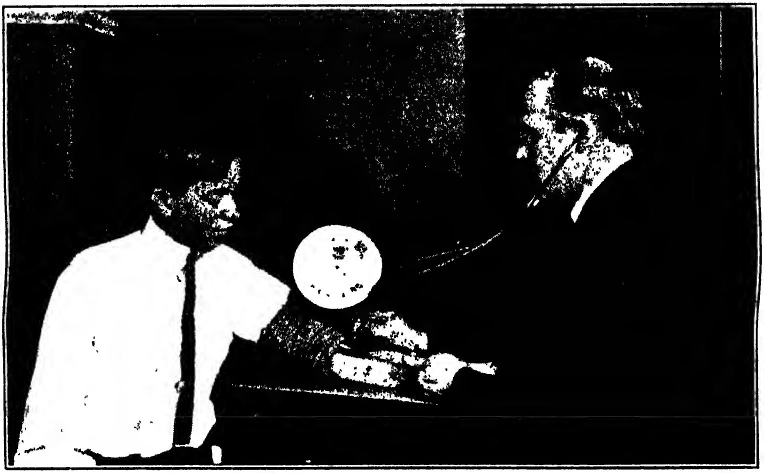
Measuring the work of the heart.

The pulse is an index to the condition of the heart and an indicator of the general condition of the system. The pulse may be made to write its own record by means of the delicate mechanism of an instrument called the *sphygmograph*. The normal pulse rate, as is seen in the accompanying illustration, gives regular, uniform curves. The long up-stroke represents the contraction of the heart, or the beat of the pulse. The irregular tracings seen below the normal tracing show how the work of the heart may be affected by disease.

There is another kind of record that may be made of

the work of the heart, indicated by what is called the *blood pressure*, which is taken by means of the sphygmomanometer, shown in the accompanying picture. The pulse tells us the *rate* of the heart beat; the blood pressure indicates the *amount of force* that is being exerted.

Recording blood pressure.



TESTING THE BLOOD PRESSURE BY THE SPHYGMOMANOMETER.

The work of the heart, as we have seen, is to force the blood through the extensive and intricate pipe system of the body. The pressure or force required to carry the blood through the entire circulation and back to the heart is equal to that required to raise a pound of water five or six feet high or a mercury column five or six inches.

In the same individual, the blood pressure varies

considerably in a state of health. When one is sitting or lying down, the pressure is lower than when one is standing or walking. That of a person sitting quiet would be less than that of the same person talking and laughing. Excitement or anger, severe muscular effort or mental strain, will cause a temporary rise of blood pressure.

The blood pressure depends upon (1) the force of the heart beat; (2) the elasticity of the blood vessels; (3) the volume and thickness of the blood. The pipe system of the body is not, as you know, like the water mains of a city, — made of hard, inelastic pipes. It is composed of elastic tissue which is able to adjust itself to varying conditions. When, for instance, one gets excited and there is a tendency to a rise of blood pressure, the elasticity of the walls of the arteries allows them to stretch a little bit and so to keep the blood pressure from rising so much as it otherwise would do.

The arteries have *longitudinal* muscles, which pass lengthwise of the artery, and also *circular* muscles, which pass around the artery. The smallest arteries of the body contract and dilate with a steady rhythm like the heart, but independent of it, and thus help to pump the blood along through the tissues. The muscles of the artery walls contract and force the blood onward in a manner somewhat similar to the way in which food is forced along in the intestinal tract.

The work of the arteries in circulation.

We see, then, that the arteries assist the work of the

heart in two ways: (1) Their elasticity enables them to expand when an increasing volume of blood is forced into them; (2) the contracting of the arteries helps to force the blood onward.

The evil of too high blood pressure.

It is essential that a certain degree of pressure should be maintained in the blood vessels since a considerable amount of force is required to send the blood through the fine capillaries of the body. From the large blood vessel in the center of the body — the aorta — which is about the size of the thumb, the blood vessels branch and subdivide, becoming smaller and smaller, until they are so fine that they can not be seen with the naked eye. The white of the healthy eye looks perfectly clear, and yet it is covered with minute blood vessels, little *arterioles*, through which the blood is being forced under normal pressure. So it is in the brain, in the kidneys, and in the lung tissue. These fine arterioles are carrying the blood in invisible columns, and the wall of the blood vessel is so thin that there is interchange between the air and the blood as it comes to the surface in the delicate lung tissue. If for any reason the blood pressure falls much below the normal, the force will not be sufficient to push the blood through the narrow capillaries. With low blood pressure some of the brain cells, the cells of the lungs and of the kidneys, and other delicate cells, do not get the necessary nutrition, and the tissues become impaired on that account.

Examinations made with the sphygmomanometer

show great variations in the blood pressure in disease. In fevers, shock, or other conditions in which there is great bodily weakness, the blood pressure sinks far below the normal. But in some diseases, especially in *arterio-sclerosis*, or hardening of the arteries, it rises very high, sometimes even as high as three times the normal.

When the arterial walls become shriveled, stiffened, and inelastic, there is required more pressure to force the blood through their narrowed channels. Besides this, they no longer assist the heart in pumping the blood, so that the labor of the heart is greatly increased. You can see that when the heart has to pump continually against a pressure much greater than the normal, it has to do a large amount of extra work. This causes it to become enlarged, and after a while it gets worn out, and heart failure is likely to result.

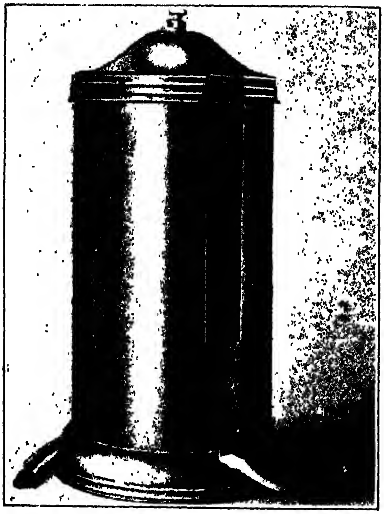
The effect of hardened arteries.

A person's real age is shown by the condition of his arteries, according to the saying often quoted, "A man is as old as his arteries." Hardening of the arteries is a sign of approaching old age. A man of seventy whose arteries are still in a soft, elastic condition is really younger than one of fifty whose arterial walls are already becoming hardened.

There are various things that cause hardening of the arteries, such as alcohol, habitual overeating, the absorption of poisons from the intestinal canal as a result of a wrong diet and constipation, and lack of sufficient

exercise. Tobacco, tea, and coffee, and also irritating condiments such as pepper and mustard, and the free use of flesh foods are common causes of hardening of the arteries.

The words of the wise king to the young man: "Keep thy heart with all diligence, for out of it are the issues of life," may well be given a physical application. A strong heart insures vigorous circulation and an ample supply of blood to every part. Especially in the crises of life (in times of mental or physical strain or of acute disease) success or failure, life or death, may depend upon the soundness and strength of the heart.



THE SPIROMETER FOR MEASURING A MAN'S VITAL CAPACITY.

There is another measuring instrument, the *spirometer*, by means of which we can find out the vital capacity of a man; that is, the amount of air that can be changed at one respiration.

The vital capacity.

Lung capacity is determined by the *extent* of the lung surface or respiratory area, indicated by the size of the

chest and also by the *mobility* of the chest; that is, its capacity for movement. The strength of the muscles which expand the chest is also a factor in determining lung capacity.

The vital capacity is measured by an individual's breathing into the spirometer after taking into the lungs as much air as they will hold. The comparison of many records taken in this way shows that lung capacity depends much upon the height, and in men increases at the rate of nine cubic inches for every inch of increase in height between five and six feet. It is about 175 cubic inches for a man five feet in height, and about 285 cubic inches in men six feet in height. The following table shows the normal capacity of the lungs for men and women of different heights.

Measuring the vital capacity.

TABLE SHOWING VITAL CAPACITY OF PERSONS OF DIFFERENT HEIGHT

Men		Table for Women	
Height in inches	Spirometer (cu. in.)	Height in inches	Spirometer (cu. in.)
72	285	67	204
71	276	66	196
70	267	65	188
69	258	64	180
68	249	63	172
67	240	62	164
66	231	61	156
65	222	60	148
64	213	59	140
		58	132

The respiratory area or size of the breathing apparatus may be permanently lessened by pneumonia, tuberculosis, pleurisy, and other diseases which damage the lung structure. It may also be diminished by an accumulation of fat within the chest and about the heart. A very fat person or animal is always troubled with shortness of breath. This is a serious condition which should be overcome whenever possible.

No physical endowment is of more importance for a long and vigorous life than capacious lungs. In all kinds of work, both mental and physical, the lung capacity is an important factor. The intensity and efficiency of an individual's life depends very much upon the amount of air he habitually passes in and out of his body; just as the intensity of a fire, given plenty of fuel, depends upon the rate at which the air is brought in contact with the fuel.

It is possible, however, for one to take a large amount of air into the lungs and yet for the body to be deprived of oxygen. The real breathing of the body is the "internal respiration," — the taking in of oxygen by the cells. The spirometer measures the capacity of the man for taking air into the lungs but does not tell us the capacity of the blood for carrying the oxygen to the cells. This is one of the interesting things that we may learn by an examination of a drop of blood taken from the finger.

The vital resistance.

The percentage of *hemoglobin* — the normal is 100 — indicates the richness of the blood in coloring matter,

upon which depends the power to carry oxygen. A person whose percentage of hemoglobin is very low, as in the disease known as *anæmia,* is short of breath because, although he takes into his lungs a sufficient amount of oxygen, his blood is not able to absorb and

GETTING A DROP OF BLOOD TO SEE IN WHAT CONDITION THE BLOOD CELLS ARE.

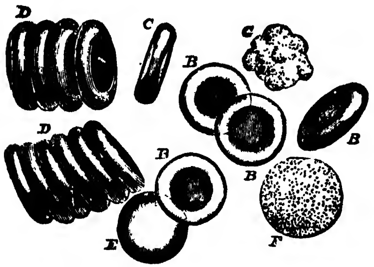
hold it; so the effect is the same as if he were breathing rarefied air or had a considerably reduced lung capacity.

Under the microscope the red and white cells in the drop of blood may be counted. The red cells of the entire body normally number about twenty-five million million (25,000,000,000,000), and if spread out on a flat

surface would cover an area of 14,000 square feet, or a space 70 × 200 feet. The red cells are the oxygen carriers of the body, and it is of great importance that they should not be diminished.

The fighting power of the blood.

The white cells, as you know, are the defenders of the body. They form a standing army always on the alert to resist invasion from mischievous germs and ready to take offensive measures against them. The white cells also assist in the healing of wounds and repairing of tissues. If from any cause the white cells are so weakened or so deficient in numbers that they are powerless to overcome the germ invaders, the body is in great danger from the germs of malaria, tuberculosis, and other infectious diseases.



BLOOD CELLS.

B, red cells seen from the side; *D*, red cells seen on edge; *F*, *G*, white blood cells.

There are certain signs by which you may know if your vital resistance is getting below normal:

Pimples, boils, or other eruptions of the skin are due to germs which have been able to get beneath the outer fortification of the skin and gain a foothold.

A coated tongue is due to a growth of germs upon it and indicates low resistance, even though the body may appear to be vigorous.

Decay of the teeth is also a sign of lowered vitality.

Watch yourself for any of these signs of lowered resistance, and, at their first appearance, take measures to increase your vital resistance. This may be done by means of outdoor life and exercise, cold baths, sun baths, swimming, and other similar measures.

The energy used in the body has but one source of supply. It is all maintained by the combustion of the material taken in as food, which is burned or oxidized by the oxygen derived from the air. The output of energy, therefore, must depend upon the intake of food, which serves the body as fuel serves a locomotive.

Measuring the amount of food required.

There are two ways of determining food value. One method is the *percentage* system, by which we may learn, for instance, that milk contains 86 per cent water, 4 per cent nitrogenous matter, 5 per cent sugar, 4 per cent fat, and 1 per cent mineral matter. The other method determines the amount of heat or energy produced by a food in the body. The last method affords the best indication of the value of a food substance in the body.

In order for a definite value to be placed on anything there must be a standard of measure for it. We measure cloth by the yard, potatoes by the peck, sugar by the pound, and milk by the pint. But we can not measure heat by length nor by weight nor by any other of our common standards of measure. The only way in which we can measure heat is *by what it can do.* The standard adopted is the amount of heat required

to raise the temperature of one kilogram of water 1° C., which is the same as to raise one pound of water 4° F. This unit of heat is called a *calorie.*

The number of calories in a food substance is determined by means of a heat-measuring apparatus called the *calorimeter.* The calorimeter looks something like an ordinary ice cream freezer. It has two outer jars, one fitted within the other, with a dead air space between. Within the inner jar is a metal receptacle containing a certain quantity of water. In this receptacle is immersed the essential part of the mechanism, the "bomb," a small, thick walled metal cell in which is placed the food to be burned. The food, which has been perfectly dried, is mixed with a quantity of *sodium peroxide* which furnishes oxygen to support the combustion. The inside of the bomb is connected by wires with a battery. When all is in readiness, the temperature of the water is taken, and then the food is ignited by means of an electrical discharge from a battery. The operator sits watching a thermometer which extends down into the water, an instrument so delicate that it registers hundredths of a degree. He notes the highest point reached and deducts from this the temperature of the water before beginning the operation. From the number of degrees increase in temperature the number of calories furnished by the food burned is determined.

By means of the calorimeter it has been found that one ounce of sugar, one ounce of dry starch, and one

ounce of dry protein, each produces about 116 calories. Fat, however, produces 264 calories to the ounce, almost two and one fourth times as much heat as either protein or carbohydrate.

Almost all of our common American foods have been examined in this way, and their energy value determined by the United States Department of Agriculture.

Food Material	Water	Protein	Fat	Carbohydrate	Ash	Calories
Beef, round lean	64.4	19.5	7.3	—	1.0	670
Beef, round fat	54.0	17.5	16.1	—	.8	1005
Eggs	73.7	13.4	10.5	—	1.0	720
Eggs, yolks	49.5	15.7	33.3	—	1.1	1705
Milk, whole	87.0	3.3	4.0	5.0	.7	325
Milk, skimmed	90.5	3.4	.3	5.1	.7	170
Cream	74.0	2.0	18.0	4.5	.5	910
Butter	11.0	1.0	85.0	—	3.0	3605
Corn meal	12.5	9.2	1.9	75.4	1.0	1655
Rolled oats	7.8	16.5	1.3	66.5	1.9	1850
Rice	12.4	8.0	.3	79.0	.4	1630
White flour	13.8	7.9	1.4	76.4	1.5	1625
Whole wheat flour	11.4	13.8	1.9	71.9	1.0	1675
Dried beans	12.6	22.5	1.8	59.6	3.5	1605
Fresh string beans	89.2	2.3	.3	7.4	.8	195
Cabbage	91.5	1.6	.3	5.6	1.0	145
Potatoes	78.3	2.2	.1	18.4	1.0	385
Spinach	92.3	2.1	.3	3.2	2.1	110
Apples	84.6	.4	.5	14.2	.3	290
Prunes	79.6	.9	—	18.9	.6	370

It will not help us much, however, to know the number of calories in a given food unless we know also the number of calories required by the human

body. This, too, has been determined by means of a calorimeter, which measures the energy expended in mental and manual work, as represented by the heat given off from the body. By this means it is possible to find out what food products are the best suited to workers with brain or with hands.

The energy expended in different kinds of work.

In the experiment, a man is shut up in an hermetically (air-tight) sealed copper apparatus, and studied night and day by scientists who watch him through a port-hole. Oxygen is pumped in and impurities removed from the air. Food is passed to him through a double trap door. His only means of communication with the outside world is by means of a telephone, through which he is told what to do. Part of the time he occupies himself with brain work, and part of the time with manual labor. During the entire time the machine is registering the energy expended under the different conditions.

When this device was invented, it marked a new era in the study of food and nutrition, as a great many discoveries were made by means of it. The experimenters were able to measure accurately the amount of heat and energy generated by foods of different kinds and the amount consumed in various conditions of work and idleness.

The amount of food required depends primarily upon the amount of skin surface, as food is needed to maintain animal heat, which is chiefly lost through the

skin. A child has a much larger skin surface in proportion to its weight than has an adult. For example, an infant weighing ten pounds has a skin surface of three square feet, while a man weighing one hundred and eighty pounds — eighteen times as much — has an area of twenty-one square feet, only seven times as much. The child, therefore, requires more than twice as much food in proportion to its weight as does the adult.

The varying needs of different people.

It must be remembered that the adult requires food chiefly to repair wastes and losses. Growing children require, in addition, material for tissue building. It has been estimated that the growing infant uses fully one third of its total intake of food in tissue building. Based upon the careful studies of numerous investigators are the following tables which give the average number of calories required daily at different ages and for people of different height and weight.

TABLES SHOWING FOR DIFFERENT AGES THE NORMAL HEIGHT, WEIGHT, AND THE NUMBER OF FOOD UNITS OR CALORIES REQUIRED DAILY

BOYS

Age	Height in in.	Weight in lb.	Calories or food units
6	43.75	45.17	850
8	47.76	53.92	980
10	51.58	65.30	1100
12	55.11	76.92	1250
14	59.88	94.91	1470

GIRLS

Age	Height in in.	Weight in lb.	Calories or food units
6	43.35	43.28	830
8	47.58	52.04	960
10	51.34	62.35	1080
12	55.88	78.31	1280

Notice particularly in the tables given below that the taller a man or woman the more food he or she requires in order to keep in health and do the best work:

MEN

Height in in.	Weight in lb.	Calories or Food Units			Total
		Proteins	Fats	Carbohydrates	
61	131	197	591	1182	1970
62	133	200	600	1200	2000
63	136	204	612	1224	2040
64	140	210	630	1260	2100
65	143	215	645	1290	2150
66	147	221	663	1326	2210
67	152	228	684	1368	2280
68	157	236	708	1416	2360
69	162	243	729	1458	2430
70	167	251	753	1506	2510
71	173	260	780	1560	2600
72	179	269	807	1614	2690
73	185	278	834	1668	2780
74	192	288	864	1728	2880
75	200	300	900	1800	3000

WOMEN

Height in in.	Weight in lb.	Calories or Food Units			Total
		Proteins	Fats	Carbohydrates	
59	119	179	537	1074	1790
60	122	183	549	1098	1830
61	124	186	558	1116	1860
62	127	191	573	1146	1910
63	131	197	591	1182	1970
64	134	201	603	1206	2010
65	139	209	627	1254	2090
66	143	215	645	1290	2150
67	147	221	663	1326	2210
68	151	227	681	1362	2270
69	155	232	696	1392	2320
70	159	239	717	1434	2390

By a study of these tables you can find out what are the requirements for a person of your age, height, and weight. Knowing the number of calories in the different foods and the number that you require daily, you may fit the one to the other and arrange your bill of fare in a quite accurate manner.

The life functions.

All the functions of the body depend upon (1) a continual building up process from material taken into the body as food and air and (2) upon a breaking down process which ends in the throwing out of the body such materials as can be of no further use to the organism. This building up and breaking down process is called *metabolism*.

It is possible to measure the metabolism of the body in

much the same way as one may measure the capacity and efficiency of a furnace. By noting the quality and amount of the fuel used in feeding the furnace and then determining the amount of heat, smoke, gas, and ashes produced, one may learn whether the furnace is working efficiently and economically. In the same way, the efficiency of the body furnace may be measured by noting the intake of materials, and the output in work, heat, and waste products.

How to measure the rate of metabolism.

One way of doing this is by means of an apparatus which estimates the amount of oxygen breathed in and of carbon dioxide breathed out during respiration. In this way it is possible to determine just how the body is utilizing the food eaten. This respiration apparatus consists of a series of bottles and instruments connected with each other by tubing. The air contained in this system is kept in continual circulation by means of a centrifugal pump and electric motor placed upon the lower shelf of the table. (See illustration.) The subject breathes from and into this current of air. The air exhaled is immediately conveyed to a large bottle containing chemicals which have the property of retaining all the carbon dioxide in the air that passes through it. This bottle, of course, increases in weight with the amount of carbon dioxide retained; and, by weighing the bottle before and after the test, one can learn the exact amount of carbon dioxide breathed out. A constant supply of oxygen is introduced into the system from an oxygen

tank as fast as it is used by the subject. This oxygen is passed through a delicate meter which accurately measures it. The amount of oxygen consumed shows the amount of work done. In this way it is possible

MEASURING THE RATE OF METABOLISM. CAN YOU DESCRIBE HOW THE TEST IS MADE, AND TELL WHAT IT SHOWS?

to find out if the metabolism is perfect or if there is any disturbance or failure in the intricate life processes whereby food is assimilated and utilized.

The meaning of human efficiency.

We must finally speak of something that is much more important than stature, weight, muscular development, or any specific physical endowment, though all of these things of which we have been speaking have their bearing

upon it. That is *efficiency*,—the power to do and to keep on doing, in the best possible way, all that the individual is capable of doing in the way of work, both mental and physical.

Efficiency is not the ability to work by spurts and spasms, by starts and stops, but the capacity, unhampered by ill health, to get out of yourself the maximum amount of work with the least wear and tear on the body.

Health the greatest factor in human efficiency.

For highest efficiency the most essential thing is perfect health—health of mind and body. A natural endowment of mental and physical ability is of course necessary as a foundation, but ill health dulls the most brilliant intellectual faculties, and weakens the stoutest muscles, while high health sharpens every faculty, gives poise and concentration, strengthens the will, brightens the imagination, and multiplies many times capacity and endurance of both mind and body.

The Committee on Conservation of Natural Resources appointed by President Roosevelt did not neglect to consider the greatest of all the national assets—human vitality. This committee pointed out the surprising fact that the average man is *only fifty per cent efficient;* that we live out less than one half the natural duration of life, that we consume more food than is needed to maintain efficient life, and that one half of all human beings born either die before reaching maturity or fall into the defective, dependent, or

delinquent classes. Special study and effort is now being made to prevent this terrible loss to the nation in human vitality and efficiency by the study of methods of race betterment.

Efficiency is not only the greatest *national* asset, but the greatest *personal* asset as well. The ability to do and to endure, to keep on doing what one finds profitable, useful, and agreeable, is the very essence of personal, social, and national well being.

The keynote of this progressive age is efficiency. Statesmen, professional men, business men, leaders in industry and politics, and workers of all classes are asking, how can I increase my efficiency? Merely to exist is not sufficient for the cultivated, up-to-date human being. To be worth while, life must be efficient, forceful, productive. The ambition to lead a forceful, useful life, to make the most of one's faculties and opportunities, is the first step in the attainment of a high degree of efficiency. Weakness of body or mind, — lassitude, lack of brightness and energy, — merely to be "below par" and to that extent inefficient, is disgusting to a bright modern man. He is not content with living a half life. He wants to live on the highest plane physically, on the top floor and not in the basement, — to be a one hundred per cent man, instead of the average fifty per cent man. In these times, any person ought to feel humiliated when he is incapacitated by disease which his own intelligent care could have prevented.

Health Problems

1. Can you think of anything that works as regularly and faithfully as the heart? If so, what?

2. Have you ever heard of an athlete who injured his heart? If so, how did he do it?

3. How does the heart act when you jump into a cold bath or pour cold water over the body? Why?

4. Suppose you had to go one mile on foot as quickly as possible. Would it be best to start off running as fast as you could, or to start slowly and increase your rate of speed gradually? Why?

5. Do you know whether the heart wears out sooner in very tall than in short men? Ask your physician this question and give the class his answer.

6. Why should overeating lead to hardening of the arteries? Ask your physician whether hardening of the arteries is a disease found among the rich or mainly among the poor. Explain.

7. What is your *vital capacity?* Compare your capacity with that of others of your age. If you are above or below the average, try to explain.

8. Why should tall men have greater vital capacity than short ones?

9. Do you know persons who are troubled with "shortness of breath"? What is the cause of this?

10. Suggest simple but effective means for increasing the vital capacity.

11. Mention habits of life which will reduce vital capacity. Explain.

12. Show that the efficiency of one's life depends to a large degree upon his vital capacity.

13. Can you tell a person who is suffering from anæmia? Explain.

14. How large a schoolyard should you have if you had one containing 40,000 square feet? Should you have guessed that

the red blood cells in all the body would cover this yard if they were spread out flat?

15. Have you noticed that your vital resistance is not as great at certain times as at other times? Explain.

16. Do you think most people should eat as much on Sunday and holidays as on work days? Why? Should people who live in the city and who do not work with their muscles eat as much as those who do hard work in the country? Explain.

17. Write an essay on this theme: "Inefficiency as the Chief Cause of Unhappiness."

18. Pick out the most efficient person you know and say just why he or she is efficient.

Review Questions

1. What causes the pulse to beat? Upon what does the frequency of its beating depend?

2. What effect does exercise have upon heart action?

3. Explain what is meant by blood pressure. How may the blood pressure be taken? Upon what does blood pressure depend?

4. Describe the walls of the arteries and explain why they should be *elastic*.

5. When does the blood pressure sink below normal? When does it rise very high above normal?

6. Why is it essential that the blood pressure should be normal?

7. What is meant by hardening of the arteries? What is the effect of hardening of the arteries upon the heart?

8. What is meant by one's vital capacity? What instrument is used for measuring vital capacity?

9. How is it possible for one to breathe in a large amount of air and yet for the body not to have enough oxygen?

10. How can one tell whether his blood carries enough oxygen?

11. Of what use are the red cells in the blood?

12. Describe the work of the white cells.

13. What is meant by vital *resistance?*

14. How can you tell when your vital resistance is getting below normal? By what measures may a person increase his vital resistance?

15. What is meant by the *caloric* method of measuring food values?

16. *Why does a growing child need more food in proportion* to its weight than a man does?

17. What is the process of *metabolism?* When is one's metabolism said to be perfect?

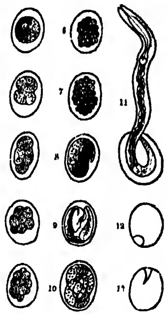
18. What do you mean by efficiency? Why should one strive for it?

19. Mention some habits which increase efficiency. Mention some which lessen it.

CHAPTER III

The Value of a Life

There is a certain class of people in the South known as "poor whites," noted for their shiftlessness and indolence. These are all native-born Americans. Many of their ancestors were of Anglo-Saxon stock, which has been called "the flower of the race."[1] Why have they degenerated into this condition of indolence, shiftlessness, and poverty?



How the hookworm develops.

1–7, segmentation of the egg; 8–10, the embryo; 11, the worm escaping from the shell; 12–13, empty shells.

A few years ago the cause was discovered, and it was found to be chiefly a *matter of ill health.* A tiny parasite, less than half an inch long and no thicker than a piece of sewing thread, was the cause of all the trouble. This little *hookworm* has been called "the vampire of the South," because it sucks the lifeblood of the people. As we have learned, it burrows through the skin, finds its way to the intestines, hooks itself on to the intestinal wall, and slowly drains the

One cause of shiftlessness.

blood of its victim. It takes away from a person all desire and ability to work and makes him "feel tired all the time."

Besides afflicting two million people with a dreadful chronic disease and slaughtering thousands of children, this tiny parasite has, it is estimated, cost the South several hundred million dollars by retarding the development of agriculture and industry.

And yet, amazing as the statement may seem, every victim of hookworm disease may be completely cured at a cost of only sixty cents each, and the disease may be entirely prevented by the most simple precautions. Some one has put it in this way: "If you owned a machine that ought to earn $300 a year and it was earning only $100 and you could restore the proper earning power by an expenditure of sixty cents, could there be a better investment for your money?"

A sixteen-year old boy was so weakened by hookworm disease that he was scarcely able to do two days work a week. He was treated, and the hookworms expelled from his body. During the next five weeks he gained seventeen and a half pounds in weight while he was working six days each week.

This is only one striking example of the needless waste of human life that is going on in the United States. What does this show us with regard to the relation of health to prosperity and success?

When the National Conservation Committee began to investigate the resources of the country, letters

were received from physicians everywhere urging it to consider the bearing of public health upon the efficiency of the nation. The need of conserving the resources of the country — the forests, coal fields, water power, and lands — was well recognized. But up to this time human vitality, the life and health of the people, had not been reckoned as one of the national assets.

The economic value of health.

The conservation of health means increased prosperity and happiness. It means, as we have seen, the ability to do *more* work and to do it *better*. Every person of sound mind and body is of value to the state. Every case of illness or early death is a loss to the community.

The requests made by the physicians led to an inquiry concerning not only the duration but also the *effectiveness* of human life. A special committee headed by Professor Irving Fisher of Yale University was appointed to make this special investigation. Here are some of the things that were revealed by the investigation:

Besides the 1,500,000 deaths that occur in this country annually (half of which are needless) there are 3,000,000 persons constantly on the sick list. The time lost in this way amounts to thirteen days, nearly two weeks, for every man, woman, and child in the United States. At least half of this sickness and loss of time is needless.

Tuberculosis, a preventable disease, carries off

133,000 persons every year. The cost of medical attendance and the loss of earnings before death average at least $2400, while, if to this is added the money that might have been earned with health, the total loss in each case is about $8000.

The loss to the country in a single year through typhoid fever, a disease easily preventable, is more than $350,000,000.

The commercial value of human life.

The value of human life can not, of course, be measured in dollars and cents. And yet, with many people in this commercial country, that is the only measurement that counts. It was a new idea to most people that human life had a commercial value and that health was a factor in determining the wealth of the nation. The publication of these figures resulted in a great awakening to the importance of improving human health.

The value of a man to his community and to the nation is determined by what he can do; and his output of work, physical or mental, depends very much upon the condition of his health. Centuries ago England's great philosopher, Francis Bacon, said: "The public health is the foundation on which reposes . . . the power of the country."

Much attention has of late been given to improving all kinds of domestic animals. Draught horses have increased in strength, and race horses in speed. Cows give more milk than formerly, pigs are bigger and fatter, sheep produce wool in finer quality and larger

quantities, chickens lay more eggs, and so on. At the same time it is to be feared that the human race is going downhill physically.

In one of the states there is a law requiring the dairymen to sterilize the skimmed milk that is fed to hogs. Before this was done, many hogs became tuberculous through infection by drinking the milk from cows suffering from tuberculosis. The result was great loss to the farmers. Now the hogs are safe, but strange to say, nothing has been done to protect the babies of the same state who are being fed the same sort of milk, or the men, women, and children who eat the cream and butter from the same milk which proved so deadly to the hogs that it was necessary to sterilize it. Should not the laws give babies as good protection as pigs?

The great educator, Herbert Spencer, said that to be a "good animal" is the first requisite to success. To be a nation of good animals is the first condition of national prosperity. Is the average American citizen a "good animal"? What is meant by a "good animal"?

"Minor ailments" prevent perfect health.

In gathering the material for his report Professor Fisher made a very extended research. He thus states the results of his important investigation:—"I have come to the conclusion that there is scarcely a well man or woman in this country after the age of forty. I mean ideally well. If you ask people if they are well, they will say, 'Yes, I am pretty well.' But if you ask them if they have sound teeth, if they have indigestion, if they

ever catch cold, if they are troubled with rheumatism or neuralgia, or any of the so-called minor ailments, they will confess, 'Oh, yes, I have a little trouble with the heart;' 'My liver sometimes makes me bilious;' 'I have a tendency to bronchitis;' 'I catch cold frequently during winter;' 'My kidneys do not always act properly;' 'I am subject to sick headaches,' and so on."

If all these "minor ailments" were eliminated, as they might be by healthful living, and all needless sickness prevented, the efficiency of human life would be *more than doubled.* Life would be not only longer, but much fuller. People would live more while they did live — put into life the full measure of work and enjoyment. More abundant life would result in greatly increased daily activity. The ideal life is not merely one that rounds out the allotted span of threescore and ten years, but one that is able to do its full measure of the world's work and claim its full share of the joy of living.

Very recently, a series of investigations has been made by the Life Extension Institute of New York City among various classes of business men all of whom were supposed to be in good health, and the majority of whom were under thirty-five years of age. The results were truly astonishing. Less than ten per cent were found to possess even fairly good health. All the rest showed very marked evidence of disease, and more than one fourth had really serious trouble of heart, lungs, or kidneys.

It is a very old adage that "each mouth has a pair of hands to feed it." But there are three classes of people whose hands are not able to feed them. You can tell who these are — the young, the sick, and the old. These must be fed by the work of other hands. The hands of those that can work must feed not themselves only but those who can not feed themselves, thus paying the debt for their own unproductive period.

The duty of those who can work.

Life is divided into three periods: the period of preparation, the period of work, and the period of rest and recreation. Most of the first twenty to twenty-five years of life are spent in preparation for work. When young men and women are cut off or incapacitated by disease just as they are beginning to do useful work, the community is robbed of their contribution to the general welfare. Do you think we owe it to others to keep ourselves as healthy as possible so that we may contribute our full share to the public good?

In a community where the average length of life is short, there are more children than adults — that is, there are more mouths than there are hands to feed them. Where the average of life is long there is a larger proportion of workers than of dependents, and this results in greater prosperity and progress. Lengthening the average human life, a thing which is being done, as we have seen, by means of hygiene, increases the productive period.

The necessity of increasing the length of the period of work.

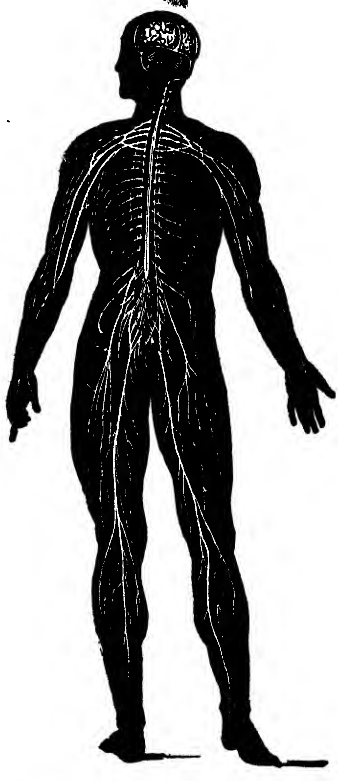
Following the period of work comes the usually idle period of old age. Some countries — Germany, England, France, Denmark — provide "old-age pensions" for those unfitted for work by age, and having no means of support. This is a serious burden on the community. But Professor Metchnikoff, who has for many years made a special study of the causes which produce the changes incident to old age, says: "We may predict that when knowledge of hygiene is more advanced, human life will become much more important than it is to-day." Especially in the aged will this result be seen. "Old age," he says, "at present a . . . burden on the community, will become a period of work valuable to the community. As the old man will no longer be subject to loss of memory or to intellectual weakness, he will be able to apply his great experience to the most complicated and the most delicate parts of the social life."

The "ruling powers" and the "servant classes" of the body.

Man has been called "an Intelligence served by organs." The "master tissues" are the nervous system and the muscles under control of the will. These constitute the man, because it is by them that all the acts of life are performed and because a man is known by what he does. In that wonderful nerve dynamo, the brain, ideas and plans are formed. The muscles carry out the purpose formed in the brain, and the man does something.

The other organs might be called the "servant classes"

of the body. The amount and quality of the work that the "master tissues" are able to accomplish depends very much upon the way in which they are aided by these "servant classes."



THE GENERAL DISTRIBUTION OF NERVES FROM THE BRAIN AND SPINAL COLUMN TO ALL PARTS OF THE BODY.

"A good master makes a good servant." If the servant organs are well treated by the master tissues, they will do perfect work and there will be no strikes nor rebellions in the body community. But if the ruling powers abuse or oppress the servant classes, they will bring trouble upon themselves. If a person overloads the digestive organs or overworks them by eating indigestible food, if he overtaxes the eliminative organs, if by lack of exercise he weakens the circulatory system, he will soon find himself hampered by inability to think clearly, to move quickly, to work vigorously.

The keen competition of our modern life compels the man who wishes to succeed to live at his best,

to keep all his organs in condition to do him the best service, so that his output of work may not be inferior, in either quantity or quality, to that of his competitors.

It is also necessary that the proper balance should be kept between the master tissues, that neither the nervous system nor the muscular system should predominate, but that the work should be properly distributed between them.

A combination of brain work and muscular work is necessary to keep man healthy and happy. Our modern artificial life often condemns one man to do brain work altogether and another man to do physical work altogether, and so it destroys the proper balance for both. The result of this is that, as John Ruskin says, "Society is made up of *morbid thinkers* and *miserable workers*." Things need to be evened up. The workman needs to think, and the thinker to work, because "It is only by labor that thought can be made healthy, and only by thought that labor can be made happy; and the two cannot be separated with impunity."

Brain work and muscular work.

Not only the worker but the work also suffers by this unnatural division. The efficiency of the brain worker is greatly increased when he does his share of physical work.

Count Tolstoy, who was a great worker, both physical and mental, said: "Sedentary intellectual work without physical exercise and labor is *a real calamity*.

If for a single day I do not walk, or work with my legs and hands, I am good for nothing by evening. I can't read or write, or even listen to any one with attention."

The efficiency of the laborer is also greatly increased when his intelligence is developed by a certain amount of brain work.

A college graduate who was in need of immediate work was put in charge of a gang of men who were shoveling dirt in some building operations. He saw that they were not putting much mind into their work, just sticking in the shovel and throwing out the dirt, and making in the process "false motions" that wasted both time and energy. He took a shovel and began to experiment, finding out how the work could be done in the least time and with the fewest motions. He then instructed the men to follow his example, with the result that the work was done in half the time that it had formerly taken. By putting intelligence into the work of shoveling dirt, he had doubled the efficiency of the workers.

Keeping up vital resistance.

Another important point for one who wants to get the most out of life unhampered by illness is to keep up the vital resistance. Before the cause of yellow fever was discovered, Dr. Sternberg, of Washington, went to New Orleans to investigate. He tested, among other things, the air from the streets, the dust of the city, the water, hunting for the yellow fever germ. When he got home, in experi-

menting with some of the germs collected, he happened to use some saliva from his own mouth, putting it in a test tube with some beef tea, and allowing it to remain overnight. He found that what developed would kill guinea pigs. Dr. Sternberg then thought that he must have got some disease germs in New Orleans and have had a narrow escape from death himself. He found, *however, that when he tested the saliva of persons in* Washington who had never been to New Orleans, he got just the same results. In every person's mouth are germs which, if allowed to grow and develop, are capable of destroying life.

The germs of pneumonia, tonsillitis, and some other diseases are always with us, ready for opportunity to attack. Riding on the cars across the Western prairies years ago, I saw a picture I shall never forget. I saw a miserable cow, nothing but skin and bone, staggering along, almost too weak to walk. A hawk was perched upon her back picking her bones. She had *lost the power to resist.*

You see, keeping up vital resistance is one of the most important things of life. Without that power, one is liable to become a miserable body with a wretched mind. The daily cold rub, physical exercise, and other health habits that keep the body in good condition are often neglected because of inconvenience or lack of time. In the end this neglect is likely to result in much greater inconvenience and the loss of much more time through illness.

We have some good examples of how much may be done for the world by one who intelligently obeys these laws. Let us consider here one or two men who have done this.

Examples of right living.

Captain John Ericsson, the Swedish-American naval engineer, not only was remarkable for the numerous *useful and wonderful inventions which remain as monuments to his skill, but was equally* distinguished for the fact that in his long, busy life of eighty-five years until his last illness *he never had a day's sickness.*

Ericsson an example of right living.

From early boyhood John Ericsson was a great worker. At the age of ten he constructed a pump which attracted the attention of Count von Platen, the first promoter of the Gotha Canal. At twelve he became connected as draughtsman with the corps of engineers employed in the construction of this canal. At seventeen he joined the army; and, because his drawings and military maps attracted the attention of the king, he was made a captain. At twenty-three he left his fatherland and went to London to introduce a locomotive of his invention. Three years later he competed with George Stephenson for the prize offered for the best locomotive. Although he did not win the prize, his locomotive, "Novelty," constructed in seven weeks' time, surpassed all others in speed. Among his important inventions are a steam apparatus for throwing water, the screw propeller, and the caloric (hot-air) engine.

Strict attention to the laws of hygiene seems to have been the secret of Captain Ericsson's remarkably healthy life in which he was able to accomplish so much. He never neglected exercise. This he obtained partly by means of gymnastics at his home immediately after rising in the morning, in connection with a cold bath, and by a walk in the open air in the evening. His diet consisted of simple, easily digested food taken at regular hours. He never ate suppers. He never let tobacco and intoxicants pass his lips.

JOHN WESLEY.

John Wesley was another of the world's great workers equally noted for his good health. It has been said of his journal that it is "the most amazing record of human exertion ever penned by man." "On horseback he traveled more miles, spoke oftener and to more people, than any other man who

Wesley a great worker.

ever lived." "Eight thousand miles was his annual record for many a long year, during each of which he seldom preached less frequently than 5000 times." On one occasion his friends urged him to reduce his labors, as they were afraid his health would be injured by so much work. To please them he reduced his speaking to three times every day in the week and five times on Sunday. So far were his excessive labors from injuring him that at eighty he writes. "I find no more pain or bodily infirmities than at twenty-five." This he attributes partly "to my still traveling four or five thousand miles (a year), and to my constant preaching."

John Wesley was a great advocate of healthful living. He wrote a book on health in an age when hygiene was almost entirely ignored. That he was extremely simple in his personal habits and allowed himself no luxuries we may judge from the fact that he lived on twenty-eight pounds ($140) a year and gave away the rest of his income in charity. He was accustomed to rise at four in the morning and to fill the day with work. He tells us of one of his early habits which doubtless helped to lay the good physical foundation for the busy life which he afterwards led. For six years he was a pupil at the Charterhouse, a school in London. During all this time he was accustomed to run three times around Charterhouse Square every morning before breakfast. By request, a friend measured for us the distance around Charterhouse Square and

reports it to be 445 yards, or a little more than a quarter of a mile. Three times around the square would be more than three quarters of a mile. A vigorous run of three quarters of a mile, if taken regularly every morning for six months, would convert many a pale, puny, listless schoolboy or girl into a rosy-cheeked, bright-eyed, vigorous youth or maiden.

Health Problems

1. What is the relation between public health and national prosperity?

2. What does "national conservation" mean? Find out what resources the United States has taken steps to conserve and tell about them.

3. Get a report from the health officer of the number of deaths in your city for the past year. What disease has caused the greatest number of deaths? How much of this sickness do you think could have been prevented?

4. Make a list of things which a community should do to preserve public health and check those which your community is doing now.

5. Explain Herbert Spencer's saying that to be a success a man must first be *a good animal.*

6. How many days in the year are you compelled to stay out of school on account of colds and other sickness? How could much of this be prevented?

7. What would happen if the employers in your community should overwork and ill-treat their workers? Might something like this happen in the body if the organs are ill-treated?

8. Write the story of some successful man you know who was also noted for his health, telling especially about his habits of living.

9. Do you know any person of seventy or thereabouts who is still vigorous and active? What habits have kept him so?

Review Questions

1. What is the "vampire of the South"? Why is it so called?

2. Explain the phrase "national asset." Is the health of the people a real national asset?

3. Mention some laws by which the United States is trying to conserve the health of the people.

4. What did Professor Fisher find in his investigations of the health of the American people?

5. Name the three classes of people whose hands are not able to feed them.

6. What proportion of the people in your community are in the period of preparation? The period of work? The period of rest?

7. How long do you think the period of work or production should be?

8. Name some habits which lengthen this period.

9. Name some which shorten this period.

10. Why is a country where the average life is short not as prosperous as one where the average life is long?

11. Is the average working life getting longer or shorter? Why?

12. What are the "master tissues" of the body?

13. Show how the "master tissues" can overwork the "servant tissues."

14. If the digestive organs were overworked, how would the whole body be affected?

15. Which of the "master tissues" should predominate — the "muscular system" or the "nervous system"? Why?

16. How did the college graduate double the efficiency of his workmen? What lesson does this teach?

17. What part does *vital resistance* play in keeping us safe from illness?

18. To what habits of living did John Ericsson ascribe his wonderful health and vigor?

19. Tell also about John Wesley's wonderful vitality.

CHAPTER IV

THE BENEFITS OF EXERCISE

HISTORY teaches us that the power of a nation very largely depends upon the physical fitness and vigor of its individual citizens. The conquering races have always been those that have given much attention to physical training.

THE GREEKS SOUGHT TO DEVELOP A BEAUTIFUL AND PERFECT BODY.

Ruling people always develop the body.

In the days when Greece rose to power and became the ruler of the world, the Greeks were devoted to athletic exercise. Their athletic sports found their highest development in the Olympic games, where contests were held in foot-racing, leaping, wrestling, and other similar sports. It was a part of the religion of the Greeks to develop the most per-

fect and beautiful body. As a result of this they have given to the world models of strength, grace, and beauty that have been an inspiration to all succeeding ages.

When Eugene Sandow was a little weak boy thirteen years old, his father took him to the Art Museum, where he saw statues of Apollo Belvedere and Hercules. "Did such men ever live?" he asked his father. "Where did they get such ideas of men?" "From the Greeks," his father replied. He then wanted to know how the Greeks became such splendid men. "By exercise," he was told. "Could I do it?" he asked. "I don't know why you could not," his father replied. The result was that Sandow devoted himself to physical training with such success that he became one of the best developed men in the world and was at one time considered the strongest man living.

The conquests of the Greeks brought them great riches, and this led to luxury and intemperance. Alexander the Great, after conquering the world, killed himself by intemperance.

In the meantime the Romans, by strict discipline and physical training, had been preparing themselves for conquest. They overcame the Greeks, and in their turn obtained control of the world. The greatest of the Romans, Julius Cæsar, spared no pains in cultivating his body to the highest degree possible. Because of this he was able to do more, to work for more hours, than any other man of his time. The greatest of Roman orators, Cicero, said, "It is exercise alone that

supports the spirits and keeps the man in vigor." But after a time the Romans abandoned their simple life and gave themselves up to luxury. They neglected their games and athletic exercises and hired gladiators for their sports and foreign soldiers to fight their battles. Then they were overcome by stronger races.

The Olympic games.

A great awakening of interest in athletics has been brought about by the revival of the Olympic games. They are held every fourth year, in a different country each time. People of all nations may compete in the athletic contests. One of the chief events is the Marathon, a twenty-six mile race commemorating the famous run of the Greek messenger to Athens with the news of the victory of Marathon. These games have aroused a new competitive patriotism. For the honor and credit of its country, each nation does its best. Many of the honors have thus far fallen to Americans, especially in the foot-racing and field sports.

Now, when you consider individuals, what kind of men do you find are the ones who fight their way to the front rank and hold their places there? Is it not usually men who have trained their muscles to hardness and endurance by physical exercise? The man of mental power needs a tough body to enable him to stand the strain on the brain and nervous system.

A good set of muscles is one of the best qualifications a young person can possess. There is no position in life which they will not enable him to fill the better for

having them. We shall glance now at some of the special benefits of muscle training.

Effects of exercise on the muscles.

Muscles differ from all machines that men can make in the fact that they grow stronger by use. The increased blood supply to an active muscle enables it to grow. Nature's first efforts towards the muscular development of the body are seen in the incessant movements of any young animal. Watch a baby kick out, when its legs are not restrained by clothing, and throw its arms about, clutching at everything. This constant activity, seen in all young animals, is one means by which their muscles are developed and strengthened.

A GOOD SET OF MUSCLES IS ONE QUALIFICATION FOR ANY POSITION.

The effects of exercise in enlarging and strengthening the muscles are easily seen in the blacksmith and the woodchopper. Their arm muscles are large and also hard, while those of persons who use their arms but little in vigorous exercise are thin and soft. When they are not used at all, the muscles become stiff, as well as weak and flabby. They will not readily obey the orders sent to them by the brain. A person who has had a long illness and has not used his legs for some time must usually learn to walk again when he first gets out of bed. It is a law

of nature that an organ that is not used dwindles and becomes useless.

It is very evident that enough exercise should be taken daily to keep the muscles strong and flexible. But it is not necessary, nor even desirable, to develop the muscles until they become very massive and hard. Heavy weight-lifting, which has this effect on the muscles, is not a good form of exercise for general development.

Keeping the muscles strong and flexible.

Charles A. Bennett, of San Francisco, was able to lift 967 pounds of pig iron with his hands; to lift 14 tons of iron in a minute's time; to put up a 158¼ pound dumb-bell, and to swing a pair of ten-pound Indian clubs 4309 times in less than an hour, and turn 205 back somersaults in fifty-four minutes and ten seconds. He died of consumption when only thirty-five years of age. One of the strongest men in America years ago was Richard A. Pennell. He was able to put up a dumb-bell weighing 201¾ pounds, making a record that for years was unequaled. During the closing years of his life he was an invalid, suffering from the effects of overexertion. These men exhausted their vitality in the performance of useless Herculean feats.

It is even more important to develop the muscles of the trunk than those of the legs and arms. Strong chest muscles are necessary for the complete action of the lungs. Strong abdominal muscles (Point these out on your own body) are needed to keep the internal organs in place, as well as to assist the breathing move-

ments. Strong back muscles are especially necessary to maintain a healthy poise of the body. Weak back muscles lead to various deformities, within as well as without — flat and hollow chest, round shoulders, spinal curvatures, and displacements of the internal organs.

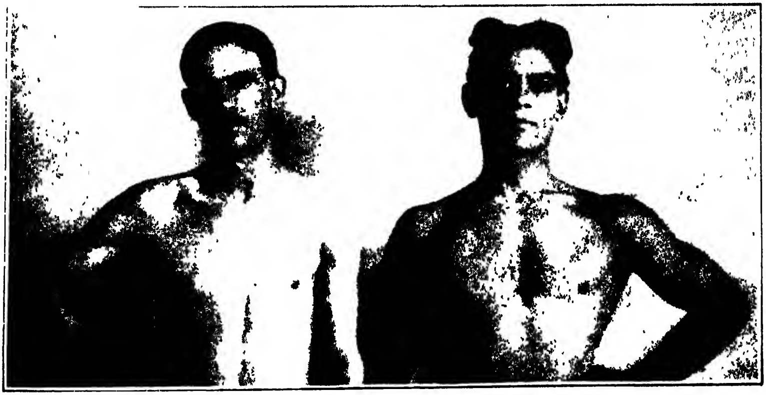
Regular exercise preserves the suppleness of the joints and ligaments, not only those of the arms and legs, but also those of the trunk, which are of more importance to health.

Effects of exercise on the joints and ligaments.

During vigorous exercise the breathing movements, as you know, are greatly increased, and the chest is expanded to its fullest capacity. As a result of this, the cartilages, by which the ribs are attached to the spine behind and the breast bone in front, are stretched and bent. Can you tell what may happen to the chest if it is not regularly stretched in this way? The cartilages will become hardened, they will lose the power to bend and stretch, and the chest will become rigid. What effect will this have upon a person's health and efficiency?

Of course, the breathing capacity will be limited in one whose chest has become rigid. This is one reason why an old person cannot run. The rib cartilages are hardened so that he is not able to expand the chest. Many a person has died as the result of pneumonia on one side, because his chest was so rigid that it could not expand to make the other lung do the work until the diseased lung recovered.

The spine also needs exercise in order to keep it flexible. The vertebræ that compose the spinal column are, as you know, separated from each other by discs of very elastic cartilage, which enable the spinal column to bend in every direction. Now suppose we do not bend the trunk in every direction often enough to keep these joints pliable; what will be the result? These

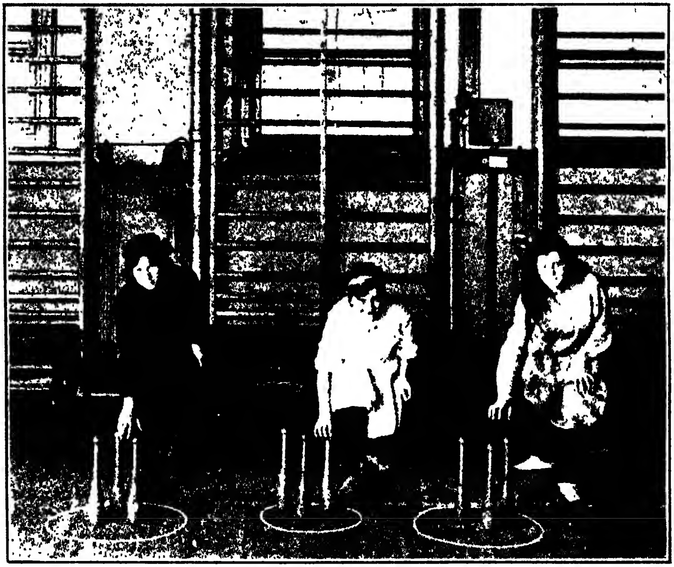


WHICH OF THESE MEN TAKES REGULAR EXERCISE?

cartilages will in time become inflexible and rigid. The ligaments also which bind the vertebræ together will lose their flexibility, and the ability to bend the spine will be partially lost. Further than this, the muscles that support the spine also tend to become rigid and shortened when they are not stretched by frequent backward, side, and forward bendings. This is one reason why we find many old people unable to bend the trunk freely.

Keeping the spine flexible.

Ask an old gentleman to bend over at the hips and touch the floor without bending his knees. It is unlikely that he will be able to do so. Why is this? It is because of the stiffness of the spinal column. If the same man had begun thirty or forty years before to take regular daily exercise



THIS EXERCISE DEMANDS SUPPLENESS, "GOOD WIND," AND SWIFTNESS.

of this kind, he would still be able to do it. A famous French journalist maintained the flexibility of his trunk to old age by picking up a pin from the floor every morning without bending the knees. But you ask, "What is the harm if a man cannot touch the floor without bend-

ing the knees? Is he not just as well off physically as one who can do so?" By no means. This stiffness in the spine, especially in the lower part, always involves a corresponding weakness of the abdominal muscles. When the spine is as rigid as a mast, the body will be held erect with little muscular effort. It is not then necessary for the muscles to be in constant play in order to keep the body balanced. This is a great disadvantage, because the muscles which hold the body erect, balancing the chest and shoulders upon the pelvis, by the same effort and at the same time hold the internal organs in position. So this rigidity of the back always means a weak, relaxed condition of the abdominal muscles, which may result in a falling of the internal organs. This falling always causes a multitude of ills.

General benefits of exercise.

When a man goes into training for an athletic event, usually, his eyes become brighter, his skin clearer, his temper more cheerful, his step more elastic, and his movements quicker. We can see how his whole body shares in the benefits of regular exercise. When the muscles are used vigorously, active changes take place, not only in the muscles but in all the surrounding tissues. More blood is required, and so the heart beats more rapidly in order to supply the demand. Regular exercise strengthens the heart and improves the circulation of the blood. It also, as we have seen, increases the breathing movements and so strengthens the lungs and increases the vital capacity. One who exercises very little easily gets out of breath,

but one accustomed to rapid walking or running has "good wind." In the latter case, a larger quantity of blood is sent through the lungs, and so larger quantities of oxygen are taken in and carried to the various tissues. The oxygen combining with the carbon of the blood and the tissues makes a larger quantity of heat. How is this superfluous heat disposed of? The sweat glands are set at work, and the skin is exercised.

WHAT DOES EXERCISE LIKE THIS REQUIRE?

In tropical countries heat increases perspiration and is to some extent a substitute for exercise in this respect. In very cold countries as in Russia and Finland, sweating baths are much used to exercise the skin and keep it clean and clear. But the sweating which is induced by vigorous exercise is a much more efficient means of exercising and cleansing the skin than any application of external heat. It makes the skin clear and transparent, smooths out the wrinkles, and makes it firm to the touch.

The effect of exercise on digestion is also very marked.

You know how the appetite is increased by a long walk, a good swim, or a rapid run. What effect does appetite have upon digestion? Nature takes away the appetite of one who does not exercise, in order to protect him from burdening his body with unused material which clogs the vital machinery and fills the blood with poisons.

Exercise and a good appetite.

BALL GAMES ALWAYS FURNISH GOOD EXERCISE.

Boerhaave, a Dutch physician who lived in the seventeenth century, noticed that hardworking people seldom suffered from indigestion, even after overfeeding. "I cannot help thinking," he said, "that most of our fashionable diseases might be cured mechanically instead of chemically by climbing a bitter wood tree, or cutting it down, if you please, rather than swallowing a decoction of its disgusting leaves."

A stream rushing down the mountain side will remain pure and clear, while the stagnant pool will become foul and slimy. In like manner the tissues of a person who neglects to exercise will become filled with waste material. As a result of lack of exercise, the food that passes into the blood may not get oxygen enough, so that products which produce disease may be formed.

The introduction of fresh supplies of oxygen due to exercise will burn up these products and render them harmless. The rubbish that has accumulated in the tissues is carried away by the rapidly flowing life stream, and the way is prepared for new material. The more rapidly old material is carried away and new material is deposited in its place through the medium of the blood, the higher the degree of life and vital activity. This rapid change does not hasten the wearing out of the body but delays it by keeping it constantly renewed.

How muscle training benefits the nerves.

When a muscle contracts, it is, as you know, in response to a message sent to it by the brain along a *nerve trunk*. It is impossible then to exercise the muscles without exercise of the nerves also. Exercise has a marked effect in steadying the nerves, giving one self-command and mental poise and readiness. Nothing so well prepares one for promptness of action in emergencies as thorough training of the muscles. A body whose every muscle is trained to precision of movement is as much more efficient and useful than an untrained body, as the well-trained horse is more serviceable than the clumsy unbroken colt.

The mind and character are influenced by physical training. Properly conducted exercises will develop one's judgment along such lines as measuring distances with the eye and calculating the amount of force required to accomplish a given end. This sort of development gives physical courage, self-control, and

self-possession. It is one of the best means of overcoming timidity. The power of accomplishing a difficult gymnastic feat gives to a youth a kind of courage and self-confidence which may enable him to overcome all sorts of obstacles in daily life.

Health Problems

1. Name two or three of the leading countries in the world. Are most of the people in these countries lazy and luxurious or are they energetic and temperate?

2. Many of the cities in our country spend thousands of dollars every year on playgrounds and gymnasiums for children. Why is this done, do you think?

3. Think of some of the great men in history. Were they men with vigorous bodies and hard muscles as well as good minds? See how many you can mention whose muscles were made strong by physical exercise and work.

4. Find out what occupations the men in your community follow who have the strongest muscles.

5. How does a person who has been sick in bed for a long time walk when he first gets up? Explain this.

6. Do you know of any old people who seem as agile and strong as many young people? If so, ask them how they have kept their muscles so flexible.

7. Describe the appearance and disposition of some one whom you know who does not take enough exercise.

8. Do you think one should exercise more in summer than in winter? Why?

9. Can you mention any games which train both the mind and the muscles?

10. Can one take too much of the wrong kind of exercise? Explain.

Review Questions

1. What were the habits of the people who lived in Greece and Rome when these countries were great and powerful?

2. What happened when the people became lazy and self-indulgent?

3. Tell what you can about the Olympic games.

4. How may one make his muscles hard and strong?

5. What would happen to the muscles in a man's arm if he did not use the arm for a year?

6. Would it be a good thing to develop the muscles until a person could lift exceedingly heavy weights? Why?

7. Why should the muscles of the back and chest be developed especially?

8. What are *ligaments?* What is necessary to keep them supple?

9. Why are old people often slow and stiff in their movements?

10. What exercise will help to keep the spine flexible?

11. Which have stronger muscles as a rule — girls or boys? Why?

12. Tell in what ways the whole body benefits from exercise.

13. Is a person who stays quietly indoors most of the time as cheerful as one who plays and works out of doors? Why?

14. What effect does regular exercise have on the *vital capacity?*

15. How is the skin exercised usually?

16. In very cold countries what is sometimes done to exercise the skin?

17. Describe the effect of exercise on digestion.

18. How does lack of exercise injure the tissues?

19. How may the worn-out tissues be renewed?

20. Tell how muscle training benefits the nerves.

21. What influence does physical training have on one's character? Explain.

CHAPTER V

Training the Muscles for Health and Symmetry

In order to be of the greatest benefit, exercise should be enjoyable. We know that appetite is necessary to good digestion. In the same way, exercise that is taken without relish, merely as one takes a dose of medicine for the sake of health, will not do us so much good as that which is connected with some interesting work or pleasure that makes it a delight.

One's daily work, when done in a good spirit, furnishes excellent exercise.

One's daily work usually provides much opportunity for healthful exercise. For girls, general housework — sweeping, dusting, making beds — gives splendid exercise, bringing into play the whole muscular system. For boys, no general exercise excels that which may be secured in "doing chores" about the house. Splitting and carrying wood, running errands, and engaging in the various employments included under the head of "chores," if done heartily, give good exercise for all parts of the body.

Gardening is a good exercise.

Using one's work for muscle training.

Working in the open air is much more beneficial than working indoors. In cultivating flowers, vegetables, and small fruits, — digging, hoeing, pruning, — one is at the same time cultivating

health and muscular development. The ancient Greek boxers practiced digging as a means of developing their arm muscles.

It has been shown that there is a difference of five inches in height and thirty-one pounds in weight between the Scotch agricultural population and the manufacturing population of Sheffield and Birmingham. This goes to show that work done out of doors tends to develop the physique much more than work done indoors.

Dr. Dudley A. Sargent, Director of Hemenway Gymnasium, Harvard University, tells how when a boy he became interested in the laws of health through reading a school physiology and resolved to make his daily labor contribute to the development of his physique. He says: "Henceforth going up and down stairs was simply a means of strengthening the muscles of the legs. Lifting weights and bearing burdens were approved ways of developing the muscles of the back and loins and strengthening the arms and shoulders. Plowing, mowing, raking, pitching, hoeing, chopping, digging, hoisting, and all the different forms of labor that fall to the lot of the country boy, were classified according to their effects in developing certain muscles of the body and were entered upon with the same zest with which one would engage in a course of systematic exercise. The proud consciousness that I was improving my physique and adding to my strength and vigor, lightened the burden of labor and afforded me great satisfaction."

Outdoor games and sports are among the best forms of exercise because they give at the same time fresh air and enjoyment. The exercises that are most beneficial to the body in a general way are those that bring into play the large muscles of the body, especially those of the legs, as in running, swimming, hill climbing, and rapid walking.

The best forms of exercise.

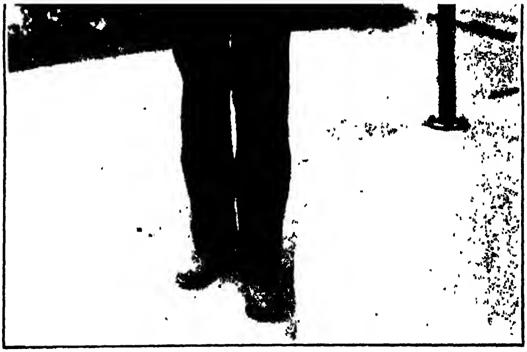
Walking, in these days of steam cars, street cars, automobiles, telephones, and the like is becoming almost a lost art. The city youth who wishes to go a few blocks usually jumps on the trolley car. The country boy "hitches up" every time he has to go a mile. But in gaining a little time, how much physical benefit may be lost! Some one has suggested that if a magical physician were "to invent an elixir that imparted a tithe of the virtue of a day's walk in the open air, he would be the Crœsus of pill makers. How much would we give for a bottle of his concoction! Yet we may walk for nothing, and we may begin to-day."

Do you know that when walking at the rate of four miles an hour you breathe five times as much air as when you are sitting still? What effect do you think this has upon the development of your chest? The natives of Hindostan, when they see a man going out for a walk, say, "He goes forth *eating air.*" "If," says one, "every boy in the United States would take daily one thousand slow, very deep breaths from now on throughout his life, it would almost double our vigor and effectiveness as a nation."

Robert Burdette gives this advice to young people: "Live out of doors all you can, my boy. Walk a heap. The open air, the free air, and the sunshine are as good as the exercise—better."

A twelve hundred mile walk.

The man who has done more to encourage walking than any other man in this generation is Edward Payson Weston.



MR. E. P. WESTON, WHEN SIXTY-NINE YEARS OF AGE, WALKED 1234 MILES IN LESS THAN TWENTY-NINE DAYS. HE WALKED ON COUNTRY ROADS, AND VERY POOR ONES AT THAT, MUCH OF THE WAY.

When he was twenty-nine years old he created a sensation by walking from Portland, Maine, to Chicago, Ill. Forty years later, when sixty-nine years of age, he re-

peated the walk, traveling a distance of 1234 miles in less than twenty-nine days, improving a little over the record previously made. Men have walked farther than this in the same period, but they walked on prepared tracks where they were protected from the elements. Weston traveled over country roads, many of which were very poor, and he walked in all kinds of weather. All things considered, his feat may be considered even more remarkable than that of Captain Barclay, an English pedestrian, who walked one thousand miles in one thousand hours.

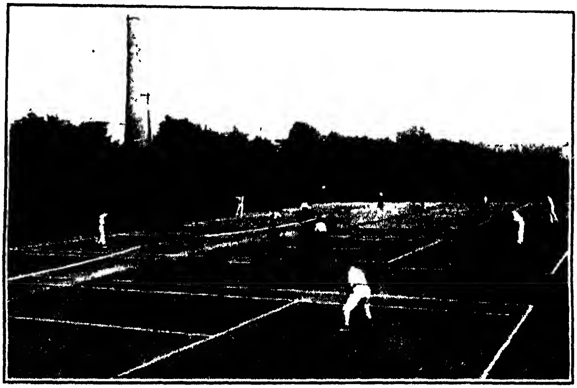
Do you think Weston could have performed this feat that attracted the attention of the whole country if he had neglected personal hygiene and regular physical exercise? His performance is especially remarkable as showing that a man of threescore and ten years may after forty years of temperate living and rational exercise be able to endure the same physical exertion that he could before he was thirty. Weston himself expressed the hope that his trip "would serve to show the young people of America what right living will do for one."

Mr. Weston stated to the writer that he never eats meat when he is taking a long walk, but confines himself to the simplest and most digestible foods, living almost wholly upon cereals and fruits.

It has been estimated that the amount of muscular work needed daily in order to keep one in health is about 150 foot tons. It is interesting to calculate the

amount of work one performs in different kinds of exercise. In walking, for example, the amount of work done is much larger than would be supposed. A German physiologist has demonstrated that in walking at the rate of three miles an hour, one uses the same amount of energy that would be required to lift his body vertically

Estimating the amount of work done in exercise.



HERE IS FINE EXERCISE FOR ANYONE.

through one thirteenth the distance that he walks. That is, to walk thirteen feet, requires as much energy as to lift one's self one foot. If a boy weighs 100 pounds, he would use up 100 foot pounds of energy in walking thirteen feet.

How far would a boy weighing 100 pounds have to walk in order to lift 150 foot tons? In lifting his body one foot the boy could do 100 foot pounds of work. To do a foot ton or 2000 foot pounds of work, he would

have to lift his body twenty times, and to do 150 foot tons he would be obliged to lift his body 3000 times ($150 \times 20 = 3000$), and to do this by walking on a level, he would need to travel thirteen times as many feet, or 39,000 feet ($3000 \times 13 = 39{,}000$), which equals 7.4 miles. Now will you figure out the distance you should walk to do 150 foot tons of work. The amount of work done would of course be increased if a burden were

WALKING 13 FEET ON THE LEVEL USES THE SAME AMOUNT OF ENERGY AS LIFTING ONE'S SELF 1 FOOT HIGH.

carried. It is evident that a very fat person will accomplish a larger amount of work in traveling a given distance than a thin person, because he carries so much dead weight. The man who weighs twice as much as he should practically carries another man on his shoulders. This renders walking much more difficult and is especially noticeable in going upstairs or uphill.

In going upstairs one is obliged to lift the body

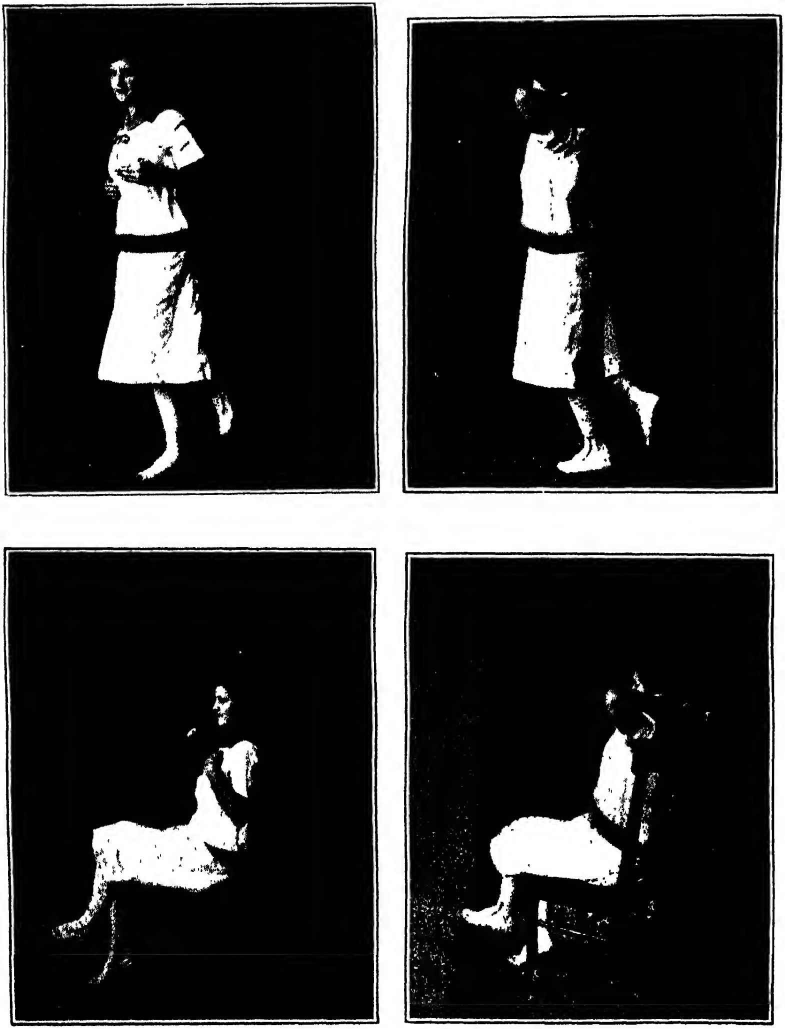
through the distance from the lower floor to the upper. If the distance were ten feet, and the weight of the person 170 pounds, this ascent would involve an amount of work equivalent to lifting seventeen hundred pounds one foot high. You can calculate from your own weight and the distance between the upper and lower floors in your house the amount of work involved in lifting your body from the lower to the upper floor, and how many times it would have to be done to accomplish the necessary amount of daily exercise, if it were all to be taken in this way.

Taking exercise in one's room.

When one's daily work does not involve the necessary amount of exercise, and it cannot be taken out of doors, it may be easily taken in one's room if desired, in such exercises, for example, as standing erect and alternately raising and lowering the heels; or bending and extending the knees; or supporting the body upon the hands between two chairs or other supports, and letting the body down as low as possible and then raising it to position — the so-called "dipping movement." In this last exercise the work is done by the arms.

A person practicing heel raising at the rate of 100 movements a minute for twenty-four minutes, rising two inches each time, would do as much work as in walking a mile. How long would a man weighing 150 pounds have to continue this exercise, to lift his 150 foot tons?

A larger amount of work may be done in the same time by lifting a pair of iron dumb-bells with the arms at



SIMPLE WAYS OF TAKING EXERCISE WITHIN DOORS.

the same time the heel raising movements are executed. For example, a person weighing 150 pounds, holding in his hands a pair of dumb-bells weighing twenty-five pounds each, making the total weight lifted 200 pounds, raising himself two inches thirty times a minute would do work amounting to 1000 foot pounds each minute, or 60,000 foot pounds in an hour. Or if at each movement the dumb-bells were raised one foot by the arms, the additional work done would amount to 90,000 foot pounds or 150,000 in all, the equivalent of lifting the body 1000 feet or walking two and one half miles.

The best time to exercise.

Some people take a long walk now and then; others crowd the chief part of their year's exercise into a few weeks' holiday in the summer. Of course this is much better than none at all, but the body requires its daily portion of exercise as much as its daily portion of food. In fact, the exercise is necessary in order for the food to be properly assimilated. It would be about as sensible to undertake to do a month's eating in a single day as to take all one's exercise for a month on a monthly holiday.

Exercise regularly, if possible at the same time each day. The body will then form the habit of exercise and will unconsciously brace itself for the work expected. Between ten and twelve in the forenoon is the best time, and the next best between four and six in the afternoon. On rising in the morning is, however, a good and convenient time for most healthy persons.

The exercise can then be taken without the restraint of the ordinary clothing, and, when perspiration is well started, can be followed by a short cold bath.

You know that when a muscle contracts, it also at the same time expands or thickens. Very firm pressure will paralyze a muscle for the time, by preventing the expansion that accompanies contraction. A muscle that is hampered by the pressure of tight clothing cannot do its work perfectly. The breathing organs, especially, should have the greatest freedom of movement during exercise. Loose garments that allow perfect freedom of movement to every muscle and organ should be worn during exercise.

How fatigue affects the muscles.

Much greater benefit is derived from moderate exercise many times repeated than from violent exercises repeated a few times. One not accustomed to exercise vigorously should begin with light exercise, always stopping short of extreme fatigue and increasing the amount of muscular work from day to day. The lifting of heavy weights or performing other work too heavy for the muscles may permanently injure them.

In order to study the effects of fatigue on the muscle, experiments have been made with muscles taken from frogs, which retain their vitality for some time after being removed from the animal. When such a muscle is stimulated by electricity, it is found that the contraction and relaxation of the muscle gradually become slower. There is an increase of power during the first

ten or twelve contractions, but after that the muscle becomes weaker and weaker until it can not be made to contract at all. If left to itself the exhausted muscle will recover in an hour or so. But if the nozzle of a syringe is inserted into the artery and the muscle is washed through with pure blood or with a normal salt solution, it will recover immediately. If the washings taken from the exhausted muscle are injected into a fresh muscle, they will at once cause fatigue of that muscle, so that it will not contract readily in response to stimulation. If the blood of a dog fatigued by excessive exercise is injected into the veins of a fresh dog, the latter at once shows signs of fatigue. Explain why exercise of a part of the body will fatigue the whole body.

Another curious experiment shows the effect of over-exertion of the muscles. One of the long muscles from a frog's leg is suspended by a piece of thread attached to one end and has a weight attached to the other end. Every time it is stimulated by a current of electricity the muscle contracts or shortens and consequently raises the weight. As the weight is made heavier it does not raise it so far and finally not at all. Adding a little more weight, we notice that the muscle *lengthens instead of shortens* when it is stimulated. You might think, perhaps, that the weight stretches the muscle. But observe that the muscle lengthens only when the stimulus is applied. When the current is withdrawn the muscle shortens again, but every time it is stimulated it stretches or lengthens. This may be one

reason, perhaps, why overstraining a muscle may injure it permanently.

An exercise to which a person is not accustomed is generally more fatiguing than one to which he is accustomed, though the latter may involve much more actual work. The amount of fatigue is more nearly proportioned to the *difficulty* of the work than to the amount done. For instance, suppose a person is made to walk a line. In one way, it is no more labor to carry the body on a line or on a narrow fence top than it is to walk on the sidewalk. Yet, if you try the experiment by walking, for instance, upon a railroad iron or a fence for half a mile, you will find it much more tiresome than walking upon a broad path, where no effort is required to keep the balance. Why is this? It is because the nervous energy is used up in maintaining the balance. The balancing effort exhausts the system by the strain upon the nerve centers.

Exercise for symmetrical development.

Most employments that are not sedentary give a sufficient amount of exercise to maintain health. Some employments, however, give undue exercise to special muscles, and this may lead to deformities. A carpenter or a blacksmith may generally be distinguished from other workers by the way in which he carries his arms. The strongly developed *flexor* muscles overbalance the *extensors* (Point out these muscles) so that the arms are constantly bent when they are at rest as well as when they are at work.

Ignorance, carelessness, and weariness often lead a person to assume awkward and unhealthful positions while he is engaged in work, and this may result in fixed deformities. It is, of course, of great importance to maintain a correct poise during work.

It is also necessary to give a little thought to the matter so as to avoid one-sided development. Most persons use the muscles of the right side much more than those of the left. Everything requiring strength or dexterity is done with the right hand. Even the right leg usually has enough more training to make it a little larger than the left. The extra work done by the right side of the body increases the strength of the muscles of this side, causing the spine to curve toward the left side, and the right shoulder to drop a little. There is probably not more than one person in four who does not have this deformity in some degree, but with proper physical training it may be avoided or overcome.

A girl whose time was chiefly spent in doing housework became remarkable for her fine physique and symmetrical development. She attributed it to the fact that she was always careful to give both sides of her body an equal amount of exercise in doing her work. For instance, when she was polishing the stove, she would do half of the work with her right arm and half with her left. When she was carrying buckets of water, she "changed hands" frequently, and regulated all her work in the same way.

Even those engaged in muscular work require special

exercise as a rule to bring into play all the muscles of the body and secure symmetrical development. A man might sit down by the roadside and spend ten hours a day breaking stones with a hammer, as men may be seen doing on the roadways of England, and the active exercise would give him a good appetite, sound digestion, and strong arm muscles; but the rest of the body, if neglected, would become seriously deformed. His limbs would become stiff, his gait feeble and awkward, and all symmetry of form and grace of movement would be lost.

Corrective exercises.

An important point to remember is that a little exercise taken in the right position is sufficient to counteract long-continued exercise in the wrong position; because in the one case we are working with Nature and in the other against her. For this reason a little *general* exercise of the whole body, taken in a correct position, will have the effect of preventing deformities that might otherwise be caused by one's work. It is a good thing, however, to give *special* exercise to those muscles that have been too long stretched or contracted.

One whose back has been bent at his work may save himself from round shoulders and a backward curvature of the spine by taking daily five or ten minutes vigorous exercise of the back and arm muscles with the spinal column in the erect position. The chest muscles which have been inactive should also be specially exercised.

To correct round shoulders and flat chest: raise the chest as high as possible, draw in slowly a long, deep breath, and at the same time press the back of the neck hard against the collar. Do this repeatedly. It will bring the spinal column into the correct position, straighten out the back between the shoulders, and deepen the chest. Persons who have round shoulders and flat chests should sleep on a hard mattress, with a very thin pillow or none at all.

THIS IS A GOOD EXERCISE FOR STRENGTHENING THE ABDOMINAL MUSCLES.

When the head is constantly bent forward in studying or working, the muscles at the back of the neck that support the head lose their tone from being continually on the stretch, as a piece of elastic over-stretched loses the power to contract. Unless the muscle tone is restored by suitable exercise, the droop of the head may become a permanent deformity. A splendid exercise for the muscles of the back is the following: Lie upon the floor face downward, and raise the head upward as far as possible. Any other exercise that draws the head upward and backward will help to strengthen these muscles that hold the head erect.

The strength of the abdominal muscles which, as we

have seen, has such an important relation to the health of the body, may be greatly increased by the following simple exercises: Walking on tiptoe with the chest held high; running around the room on all fours; lying on the back, with the legs held straight, raising them to the perpendicular, repeating ten to twenty times three times a day; lying on the back and raising the body to the sitting position with the hands placed at the back of the neck.

One whose work keeps his hands bent continually, as in rowing, shoveling, or writing, may counteract the effects of this by forcibly extending the fingers as much as possible several times in succession, at intervals during his work.

Health Problems

1. Make a list of the tasks which you do at home and which you enjoy doing.

2. Observe the people you know who work out of doors and compare them with people who work indoors. Which are the larger and stronger? Which are the more healthy and cheerful in appearance?

3. Make a list of all the outdoor games and sports you enjoy in summer. Make another list of those you enjoy in winter.

4. How far do you walk in coming to school? Is the road level or does it go up and down hill? About how many times should you have to walk this distance in order to do 150 foot tons of work?

5. Open and shut your hand vigorously and rapidly for five minutes. Do the muscles work as easily and readily at the end of the experiment as they did when you began? Why?

6. In running a long-distance race, athletes do not start out

at the height of their speed, but run only moderately fast at first. Why do they do this?

7. Try to write a simple sentence with your left hand. Is it harder or easier than with your right hand? Why?

8. Perhaps you know persons whose arm muscles are strong and well-developed, but who cannot handle a pen or a needle easily. What is the reason for this? What muscles does a blacksmith train? A writer or a needleworker?

9. Observe how many of your classmates have one shoulder higher than the other. What is the cause of this? How may it be remedied?

10. How many people do you know who carry their heads forward constantly? How may they correct this?

11. What habits in sitting, standing, reading, or writing are likely to make a person one-sided?

Review Questions

1. What is necessary in order that exercise may be of the greatest benefit?

2. What kinds of work can a girl do that will give her much healthful exercise? What kinds can a boy do?

3. What difference is there between the Scotch agricultural population and the manufacturing population of Sheffield? Why is there such a difference?

4. What sports afford the best exercise?

5. Why is walking so beneficial an exercise?

6. Tell about the achievements of Edward Payson Weston.

7. How much daily exercise is needed in order to keep one in health?

8. Why does a fat person use up a larger amount of energy in walking a given distance than a thin person?

9. Describe some good exercises which may be taken in one's room.

10. Is it well for a person to crowd all his exercise into a few weeks in the summer? Why?

11. What is the best time for taking exercise?

12. What is the effect of tight clothing worn while a person is exercising?

13. Why is very violent exercise repeated a few times not as beneficial as moderate exercise repeated many times?

14. What effect does fatigue have on the muscles?

15. Why does exercise of a part of the body fatigue the whole body?

16. What is the effect of overexertion upon the muscles?

17. Why is work to which a person is not accustomed more fatiguing than work to which he is used, although the latter may require more muscular effort?

18. Explain how certain kinds of work cause a one-sided development of the body.

19. What should be done to insure the symmetrical development of the muscles?

20. What is meant by *corrective* exercises? Of what value are they?

21. Describe an exercise which will correct round shoulders.

22. Describe an exercise which will strengthen the abdominal muscles.

23. How may one prevent his fingers from becoming bent and crooked?

CHAPTER VI

Food and Efficiency

An engineer can measure the exact amount of work that a locomotive can do on a given quantity of fuel. He knows, for instance, that a ton of hard coal will carry a train a certain distance. The same weight of soft or bituminous coal would not carry the train so far, because it gives off less heat; and since the fuel value of a ton of wood is still less, the distance that could be traveled on it would also be less. That is, the amount of work that can be done depends upon the quality and amount of the fuel burned. It is the same way with the human body. It is possible to determine, as we have learned, by means of the calorimeter, just how much heat is liberated when food is burned and, consequently, the amount of work that it may enable the body to perform. How many heat units or calories are furnished by an ounce of fat? How many by an ounce of sugar, starch, and proteid?

The ideal diet.

The important question for us is, how best to maintain the body in a condition of health and strength; or in other words, to establish *the highest degree of efficiency*, with the *least expenditure of energy*. You can see that the eating of unnecessary food means a

loss of energy to the body in handling and getting rid of the surplus. There is unnecessary "wear and tear" on the digestive and eliminative organs, and any excess is not only useless, but is likely to prove injurious. The ideal diet is the smallest amount that will suffice to keep the body in a state of continual vigor; the diet that will give the *maximum of energy* with the *minimum of expenditure.*

Recall what you have learned as to the uses of food in the body: (1) to repair the body tissues; (2) to furnish heat and energy.

The building material of the body.

The material for building and repairing the body is furnished by the proteins in the food. The body is constantly wearing out and must be constantly renewed. Protein food is needed for this purpose. If not supplied in sufficient quantity, the body would not be repaired as fast as it wears out. A person who would continue such a diet for a long time would in time waste away and die. It is possible for one to starve on a diet consisting wholly of foods in which there are no proteids.

The amount of protein consumed by the body is shown by the amount of nitrogen thrown off. Two men carefully noted the amount of nitrogen excreted on a day in which they did no vigorous muscular work. The next day they climbed a mountain 23,733 feet high, and they found that there was no increase in the amount of nitrogen excreted. This showed that the extraordinary work was not done by the aid of protein,

but by the energy derived from fats and carbohydrates, the starch and sugar of the food. Numerous experiments made since have shown the same thing.

The fuel foods.

The fats and carbohydrates, which are the fuel foods, do not form muscle, bone, nerve, and sinew, but only supply heat and energy by being burned up in the body. They may be stored up in the form of fat, which is reserve fuel to be used by the body when needed, just as fuel is stored for future use in the tender of a locomotive.

It is not necessary to eat much fat in order to be fat. The body is able to manufacture fat out of carbohydrates (starch foods and sugar). A German chemist, Professor Liebig, kept a record of the fat in the food given to a cow, and he found that the fat which the cow gave out in her milk far exceeded the amount of fat that she ate in her food. An experiment made with some young pigs showed that they stored up more than four times as much fat as was given to them in their food.

Some of the carbohydrate food is stored also, you may know, in the form of *glycogen* or "animal starch" in the liver and muscles. In this respect the liver seems to act as a kind of savings bank or place of deposit for some of the fuel not needed for immediate use, dealing it out as needed in the form of sugar.

Proteins also may be used by the body as fuel, but this occurs only in case of necessity. People living in cold climates, in cases where there has been a coal

famine in the midst of a severe winter, have sometimes had to burn up their furniture for fuel. When that was exhausted they have even been known to tear down a part of the house and burn it. It was better to mutilate the house than to perish with cold. In like manner, when a person is deprived of food, the body first draws on its reserve fuel and burns up its store of fat. When this is used up, some of the flesh also has to be consumed in order to maintain enough heat to keep life in the body. In such cases, of course, proteins, being the building material of the body, are used for fuel.

"Clinkers" in the body.

Another case in which the body is obliged to burn protein is when an excess of protein food is eaten and absorbed into the blood. We have noted the ways in which the body is able to regulate the supply of the fuel foods to meet its needs, as a self-regulating furnace controls by an automatic device the supply of coal to the fire. But for the proteins there is no such provision. The protein absorbed into the blood that is not needed for immediate use must be burned up in order to get rid of it, — to get it out of the body. So if the body does not need the protein for repairs, it will use it, but it is a bad form of fuel, for it leaves behind what might be called "clinkers."

When fats and carbohydrates are consumed they leave no ashes. They are changed into carbonic acid gas and water, both of which are easily eliminated. The carbonic acid gas is exhaled through the lungs and

the water passes off through the kidneys and the skin. With protein foods the story is quite different. These, oxidized, yield substances that are not ready for elimination by the kidneys until they have been chemically changed by the liver. These products -- frequently spoken of as tissue toxins (poisons) — circulating through the body may have an injurious effect. When present in large amounts, they dull the brain and irritate the nerves and may even be deposited in the tissues and cause hardening of the arteries, -- premature old age.

You can see that while a sufficient amount of protein is absolutely necessary to the body, great excess is very likely to prove harmful. It throws much extra work upon the liver and kidneys, which may result in serious injury to these organs because of the formation of poisonous waste substances, due to the fact that the body can not burn protein completely as it does starch, sugar, and fat.

Besides, and this is a highly important fact pointed out by Rubner, the great German physiologist, the energy resulting from the burning of the excess of protein eaten can not be utilized by the body as is the energy of starch and fat. Energy can be gotten out of the food only after it has become a part of the cell. The excess protein is never assimilated, it never becomes an actual part of the living body, it is burned to get rid of it, just as we sometimes burn rubbish in a bonfire. Even the heat produced is extra heat which the body does not need, and so it is carried off by an increase in

the insensible perspiration. Under conditions of extreme exposure to cold the heat might be of service. On the other hand, in cases of fever, and in hot weather, the heat excess induced by too much protein may do great harm.

A peculiar trait of proteid. Rubner found that when a dog is fed protein alone, 40 per cent more food is required to maintain his weight than when he is fed on a mixed diet containing a proper proportion of carbohydrates and fats. This is the reason why meats of various sorts are sometimes called "heating" foods. An ounce of protein burned in the body gives rise to more heat than it could alone furnish. The extra amount of heat is obtained by burning the body tissues.

Still another highly interesting and most important fact shown by careful experiments upon dogs and men is that protein is so poor a source of energy that it actually causes an expenditure of more energy than it supplies. In other words, it excites the body cells to expend more energy than it furnishes, so that it may become a source of serious loss when used in excess.

Protein is the most necessary element of our food, though a comparatively small amount is sufficient for the needs of the body. Taken in excess, it causes waste of energy in digesting, absorbing, and eliminating it, which means a strain on the liver and kidneys and an increase in the body of poisonous products which are very likely to prove harmful. When carbohydrates and fats are eaten in excessive amounts, there is the

same waste of energy in digesting, absorbing, and burning them, but the products they form are much more easily eliminated. They may also be stored as fat for future use, a quality which is not true of protein.

From a study of a food table, we may learn that most of our foods contain all three elements, though in greatly varying proportions. Lean meats consist mostly of protein, with a little fat. Eggs have also a very high proteid value, especially the white; the yolk of egg contains a good deal of fat and is relatively low in proteid. Milk, cheese, peas, beans, and peanuts are all fairly high protein foods. Bread and cereals are largely carbohydrates, but partly protein. Fruits and most vegetables are low in proteid.

The amount of food needed.

You can appreciate that it is not possible to determine the exact amount of food needed and to lay down any fixed rule, because the amount needed varies greatly, not only with different individuals according to age, size, sex, and so on, but also with the same person under different conditions. The amount of muscular work greatly influences the amount of food needed. Why should this be the case?

It has been found that for brain work the body consumes very little if any more food than when at rest, though not sleeping. In cold weather the appetite is keener than in warm weather. More heat is lost from the body, and so more food is needed to maintain the body temperature. What kinds of food do you think

it would be best to increase in order to supply more heat to the body? Muscular activity is usually greater in cold than in warm weather, a condition which is one reason why people eat more in winter than in summer.

Experiments and investigations made in recent years have thrown great light on the subject of nutrition, especially with regard to the regulation of the diet to produce the highest efficiency.

Economy in nutrition — its effects on efficiency.

Some years ago, Mr. Horace Fletcher found that when, with his attention fixed upon the taste of food and the enjoyment of the fine flavors in it, it was masticated until it disappeared of itself, without forced swallowing, his appetite was satisfied with a much smaller quantity than he had formerly been accustomed to eat. This economy in nutrition relieved the body of a great burden, and his health, which had become impaired, began at once to improve.

Experiments were undertaken by Mr. Fletcher in Cambridge University, England, under the supervision of Sir Michael Foster, the eminent physiologist, and at Yale University, under the supervision of Professor Chittenden, also an eminent scientist.

In Sir Michael Foster's report of the experiments he said: "The adoption of the habit of thorough insalivation of the food was found to have an immediate and very striking effect upon appetite, making this more discriminating, and leading to the choice of simple food, and in particular reducing the craving for flesh

food. . . . All subjects of the experiments who applied the principles intelligently agreed in finding a very marked reduction in their needs and experienced an increase in their sense of well-being and *an increase in their working powers.*"

Experiments with the "low-protein" diet.

Professor Chittenden undertook a series of experiments for the purpose of determining the value of a low-protein diet. A company of soldiers from the United States army volunteered for this experiment. For the first two weeks the ordinary army rations were given to them, and then the amount of proteid in the food was gradually reduced until it was less than half that to which they had been accustomed. During the experiment, which lasted about six months, the men were given daily vigorous exercise in the gymnasium.

At the beginning of the experiment and at its close the strength of the men was tested by means of the dynamometer. It was found that every one of them had made a great gain in muscular strength, in some cases more than one hundred per cent; that is, they had more than doubled their strength. They were less aware of fatigue than formerly, and could do more work without the feeling of fatigue that usually accompanies muscular work.

To place the matter beyond question, another series of experiments was made. Men in training for athletic events usually think it necessary to eat large quantities of proteid food, and this is why meat has such a

prominent place in their diet. A group of students in the university, all athletes, was secured. These men gradually cut down the amount of proteid food in the same way as the soldiers had done. To make sure that they were not losing in strength, dynamometer tests were taken each month. These tests showed, on the contrary, a marked gain in strength, which seemed to increase as the amount of proteid diminished. One of the athletes during these experiments won two championships — the Collegiate and the All-round Intercollegiate Championship of America. The Director reported that they had gained not only in strength, but in ability and skill. These men were all athletes who had been in training for months, and in some cases for years, and were said to be "in the pink of condition"

Courtesy of the *New York Evening Mail.*

THE MEN WHO WIN IN GREAT FEATS OF ENDURANCE, AS IN THE MARATHON RACES AND OLYMPIC GAMES, LIVE ON LOW-PROTEID DIET, AND SOME OF THEM ABSTAIN FROM FLESH EATING.

when they began the tests. In their case, therefore, the gain could be attributed only to the diet.

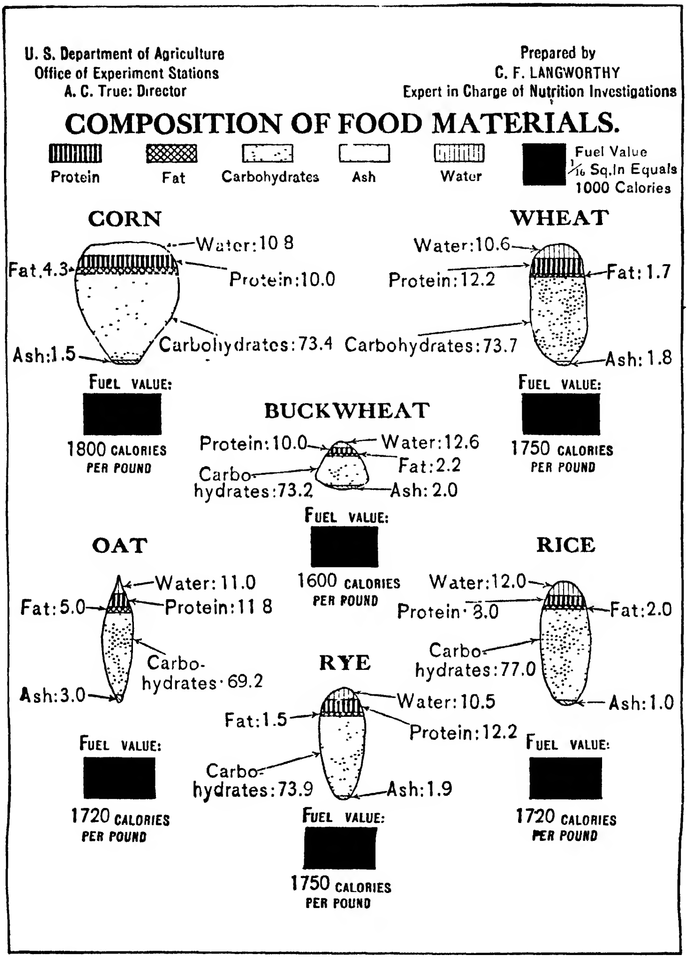
Relieving the organs of unnecessary labor.

All these experiments, taken together, show that the body may be relieved of a great amount of needless labor, which means a saving of energy, by reducing the amount of proteid food to much less than the average; and this may be done not only with no loss, but with great gain in working power. The bodily economy is not the only gain. The increase in working power means an increase in earning power and a diminishing of the loss of time through sickness. The improved health also means a saving of doctors' bills. The foods high in proteid are as a rule the most expensive items in the diet, especially when the proteids are taken in the form of animal foods. If a family can be amply nourished on a less expensive diet than it is accustomed to, it is evident that there will be more money to use for other purposes. Professor Chittenden even goes so far as to say that if the use of food was reduced to a true basis, "the saving to the community and to the family might well amount to enough to constitute the difference between pauperism and affluence."

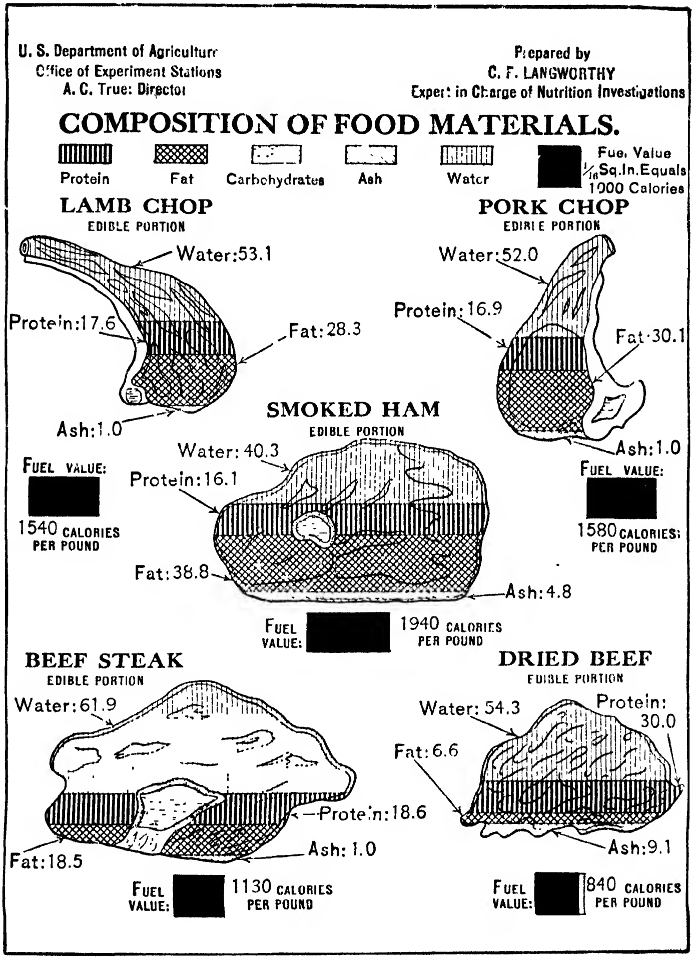
The selection of food.

What is the source of the food supply of the world? You remember what we learned as to the difference between animals and plants in this respect. Are animals an original source of food?

In the process of growth the plant stores up the sunlight, which is the source of nearly all the energy on



Composition of cereals.



COMPOSITION OF MEATS.

earth. The heat of the sun raises water by evaporation and forms clouds, which float inland until they reach a mountain peak, when the moisture is condensed and flows down the mountain side. Man puts a wheel in the current and the wheel turns the mill; so the water-wheels and mills are really turned by the sunlight. The sun at the equator warms the air; it arises and flows out toward the poles, and the air from the poles, being cold, flows back along the surface of the earth. Man puts up a wheel in the air and the wind turns the wheel. Coal and petroleum are sunlight stored up in the earth. These are burned in furnaces and make steam which turns engines; so the machinery is turned by the sunlight. The same thing is true of animal energy. The farmer plants grain, which under the influence of sunlight grows and multiplies; he feeds it to his horses, which expend the energy from the sunlight through their muscles in pulling heavy loads. Our muscular energy, our brain and nerve energy, come from the sun through the food we eat.

A locomotive or a stationary steam engine is a means for using stored energy. The human locomotive is also a means of using stored energy. The order of Nature is that the vegetable world stores up the sunlight, and the animal world expends the energy. What bearing does this have on the natural food of man? Is the food material improved or not in being first used by some other animal? What is added to it? What is taken from it?

Some time ago an eminent London physician was called to the zoölogical gardens to find out the cause of the great number of deaths among the baby lions. He found that the trouble was that they were being fed entirely on meat and were not getting any lime in their diet. He told the keepers to give them some ground bones also. After they did this the lions thrived. When the pig and the ox eat grain, the lime in it goes to nourish their bones. In order to get back the whole of the grain we should have to eat the whole animal, bones and all.

Natural foods.

Natural foods are sometimes modified by milling and so on so as to remove some of their valuable elements. In whole wheat, for instance, we find nearly everything that the body needs, — a sufficient proportion of proteid, carbohydrates, and the necessary mineral salts. But in the process of milling, in order to obtain fine white flour, the valuable mineral salts are largely lost. It is thought that the early decay of the teeth which is now so common is largely the result of "lime starvation," due to the diet's being composed largely of meat and white bread. The English Government has thought this matter of so much importance that a "standard" for bread making flour has been issued, and the people are being instructed and encouraged to give up the use of white bread entirely and to use only the "standard bread" made from whole wheat flour.

A large part of the human family have from the

earliest times used only food of vegetable origin, principally fruits, grains, nuts, and other seeds. At the present time these substances form the principal food of at least two thirds of the human race. The 300,000,000 people in India live almost entirely upon rice and dahl, a preparation of lentils, with a little oil or melted butter. Rice is also the chief article of diet of the 400,000,000 of China and Siam, and of the sturdy Japanese race. The millions living in the central portion of Africa live chiefly upon the natural vegetable products of the forest. The cocoanut, the plantain, and the banana form a very large part of the dietary of Central America and the West Indies.

The best guide in the selection of food is instinct. But with many people the instinct that should guide them in this respect has been changed by wrong methods of eating. The "hurry habit" is largely responsible for overeating, so common in our country. The best means of training the appetite so that it will be a sure guide to the needs of the body is, as Mr. Fletcher has shown us, thorough mastication of every morsel. The stopping point should be the *earliest* moment at which one feels satisfied.

Accidental discoveries.

You may remember about Alexis St. Martin, the man who had an opening in his stomach caused by a gun-shot wound and who was kept under observation by Dr. Beaumont. Alexis signed a contract to submit to all kinds of experiments for one year. During this year, Dr. Beaumont made some inter-

esting discoveries which have since been confirmed by later investigators.

He discovered that taste has a marvelous effect on digestion. When Alexis ate food that he liked, more gastric juice, which is necessary for digestion, was poured out in the stomach than when he ate food that he did not like. This important fact was almost lost sight of until Professor Pawlow discovered the same thing in his experiments on dogs. The more the food is enjoyed, the better it will be digested. You have seen people bolt their food almost without tasting it at all. Such people are likely to suffer from indigestion.

Dr. Beaumont also anticipated Horace Fletcher in discovering that thorough mastication greatly lightened the work of digestion, — that the longer the food remained in the mouth, the less time it was in the stomach.

He also discovered that condiments, such as mustard and pepper and other substances that are "hot" when they are cold, irritated the lining membrane of the stomach and caused it to pour out mucus, laying the foundation for gastric catarrh.

Baking powder, soda, and cream of tartar, which are used in cooking as a quick and convenient way of making light bread, cakes, and such foods, are likely to hinder digestion by stopping the flow of the gastric juice. Pawlow found that while a pint of water put into a dog's stomach caused an abundant outpouring of gastric juice, if a grain of soda were added to the water no juice at all was poured out. Though the daily

use of these things may be small, their continued use day after day for months and years may not only interfere with the action of the gastric juice, but may finally destroy the power of the stomach to make it at all.

Another substance which hinders digestion is vinegar, a single teaspoonful of which is sufficient to prevent the action of the saliva upon an ordinary meal. It has been shown that acetic acid — the acid of vinegar — is as powerful as alcohol in producing injury to the liver and kidneys. Lemon juice is a perfect substitute for vinegar.

Dr. Beaumont noticed that *bulk* in food helped digestion, because it stimulates the wall of the intestine, and so helps the rapid transit of the food through the alimentary canal, which is not likely to be the case when food is too condensed. This is a matter of great importance, because when the food stagnates in the canal, germ poisons are produced which cause what is called "auto-intoxication," about which you will learn more later. Fruits and vegetables give the necessary bulk to the food.

Irritating the stomach.

An important source of disturbance to the mucous membrane of the stomach and intestines is cane sugar when taken in large quantities. This substance is not found in nature in the condition in which it appears upon our tables. It takes about twenty-five pounds of maple sap to make one pound of sugar. This is a hint that sugar was not intended by nature to be used in the concentrated form

to which it is reduced in these times. No provision has been made for its digestion in the stomach, and it is therefore acted upon by the bacteria of fermentation, which change it into irritating acids. We have only a small quantity of the *enzyme* that digests cane sugar in the intestine, which would also indicate that it should not be taken in large quantities.

It has been suggested that the "sweet tooth" that nature has given us is for the purpose of coaxing us to masticate our food thoroughly, because, when cooked starch is thoroughly masticated, it is partially changed to natural sugar in the mouth. Man originally obtained his sugar from starchy foods, which in the process of digestion he changed into malt sugar and also from sweet fruits and from honey. These natural sugars are very easily assimilated. But he now produces sugar in a concentrated form, and adds it to his food in large quantities, and even eats it alone in the form of candy. By this means the appetite is tempted long after hunger has been satisfied, and it becomes so perverted that it can no longer be depended upon as a guide. The taste for natural food is destroyed, and everything must be sweetened to satisfy the unnatural craving produced by the use of sugar. The normal appetite for sugar may be easily satisfied by a little natural sugar such as is found in raisins, figs, dates, malt sugar, or honey.

A German chemist observed in experiments upon a dog that a solution containing only six per cent of cane

sugar caused irritation with reddening of the mucous membrane. A ten per cent solution produced a dark red color with great irritation and caused the animal great pain. You can appreciate that sugar should not be taken alone into an empty stomach. Taken in small quantities in connection with the meals it will probably do no harm to a healthy person.

The need for uncooked food.

Lettuce, celery, radishes, cucumbers, and ripe fruits are valuable because they supply the need of the body for raw food. The great attention that has of late been given to the diet of babies has brought out the fact that a diet of cooked food alone cannot be taken for more than eight or ten days without harm. If continued for a long time in babies it produces rickets. It is now known that scurvy among sailors is due principally to the lack of raw food. Cooking is a process which, while it renders some foods more digestible, seems also to destroy some of the finer elements of the food that the body requires for perfect nutrition.

Cooking is a sort of preliminary or external digestion for those foodstuffs which are not prepared by nature ready to enter the digestive apparatus. It is especially required for foods containing raw starch — the cereals and vegetables. Unripe fruits, which also contain starch, need cooking to make them digestible. Meat and fish, while not made more digestible, are made very much more appetizing and agreeable to the taste by cooking; and the bacteria which they fre-

quently contain, as well as any possible parasites, are destroyed by the heat. The object of cooking, therefore, is threefold: (1) to increase the digestibility of food; (2) to make it more appetizing; (3) to destroy bacteria and parasites.

Foods eaten raw may introduce into the alimentary canal large numbers of microbes which are not found in cooked foods. Raw foods should always be carefully washed before being eaten, even when they can be shelled like nuts or pared like some fruits. To be rendered safe, uncooked foods should be dipped in boiling water or immersed for a few minutes in a five per cent solution of peroxide of hydrogen.

While food may be rendered more digestible by proper cooking, it may also be rendered indigestible by improper cooking. Frying is a bad form of cookery. The gastric juice has no action upon fat, you remember; so when a particle of food is encased in a coating of fat, the digestive juice cannot reach it, and it passes through the stomach undigested.

So-called "brain foods."

We sometimes hear certain foods recommended as "brain foods" and others as "muscle foods." Do you think it would be possible to build up any special organ by any special food? Fat may, of course, be developed by feeding fat and carbohydrates, but fat is just reserve tissue and not an organ. All the cells of the body, as a physiologist has said, "have a common ration, and practically sit at one table, very much as officers and soldiers do when

engaged in actual warfare. No one then thinks of giving to officers brain food and to common soldiers muscle food, but rather a good, general 'all-round' food supply." The best food for the brain, as well as for the muscles, is good, wholesome, natural food, well selected, well prepared, well chewed, and well digested. The brain seldom suffers from lack of nourishment. Experiments have shown that even in starvation the brain suffers little if at all until the last stages, when the whole body has been reduced to the lowest possible degree.

Health Problems

1. Write the menu of your meals for a day to find out from the food table the percentage of fats and carbohydrates and protein contained in each food. Are your meals well balanced or is there too much of one element in them?

2. If you were repairing your house, would you buy more building material than you needed so that the surplus cluttered up your house? Do you think it a wise thing to clog one's body with surplus building material?

3. Is it well to store up a large surplus of fuel in the body in the form of fat?

4. Which is the more economical kind of coal to purchase — that which when burned leaves very little ashes or that which leaves great "clinkers"? What fuel leaves clinkers in the body? What kind leaves no ashes?

5. When is your appetite the keenest, — when you have been sitting still or studying quietly all day, or when you have been doing active muscular work?

6. Try Mr. Fletcher's method of eating food, masticating each morsel until it disappears of itself, without effort in swallowing.

Do you eat as much food at a meal when you eat slowly in this way as when you bolt it down?

7. Give all the reasons you can for eating food slowly.

8. Plan a simple dinner for three persons and find out the cost of each article mentioned. What kinds of food are the most expensive? The least? How about the cost of protein and of non-protein food?

9. Which is digested the more easily — food which you like or food which you do not like? Should a person ever force himself to eat what he strongly dislikes?

10. It has been suggested that we might eat our food in the form of small tablets containing the right amount of fats, carbohydrates, and proteids. Why would this not be advisable?

11. Take a dry crust of bread and chew it thoroughly. How does it taste? Why has nature given us a "sweet tooth"?

12. When may candy be eaten in small amounts without harm to the body? Name some foods which contain natural sugar.

13. What is said in this chapter about the need of the body for raw food? What raw foods do you eat? Tell how you prepare them for eating.

14. Why does one sometimes have an attack of indigestion after eating a meal of doughnuts?

15. What is the trouble with a person when he has rickets? scurvy?

Review Questions

1. What are the uses of food in the body?
2. What food furnishes the building material of the body?
3. What are the fuel foods? What do they furnish to the body?
4. Could one exist on any of these foods alone? Why?
5. In what form are the fuel foods stored in the body?
6. Is proteid food ever used as fuel?
7. Does it make good fuel? Why?

8. What harm is caused by taking an excess of proteid food?

9. What common foods contain a great deal of protein?

10. What common foods are largely carbohydrates and fats?

11. Can the amount of food needed by a person be exactly determined? Why?

12. How does the amount of food needed vary with a person's occupation? With the weather? Why?

13. Describe the experiment made on soldiers of the United States army to test the value of a low-protein diet.

14. What effect did this diet have on the athletes who tried it?

15. What is the original source of food?

16. Is food material improved by being used by some other animal before man uses it? Explain.

17. What is taken from wheat in the process of making white flour? Why is whole wheat flour better than white flour?

18. Name some condiments. What injury does their use cause? What substitute is there for vinegar?

19. In what way do baking powder and baking soda hinder digestion?

20. What is the importance of *bulk* in food?

21. How does cane sugar eaten in large quantities affect digestion?

22. Of what value are raw foods? What care should be taken in their preparation?

23. Name three benefits from cooking food.

24. Can particular foods be classed as "brain foods" or "muscle foods"?

CHAPTER VII

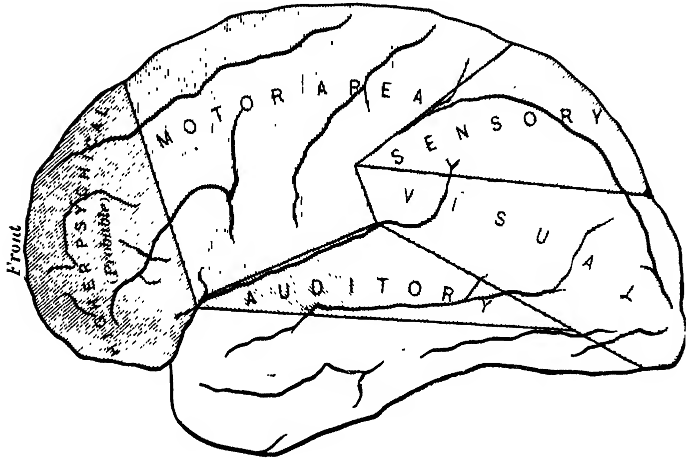
How the Body is Governed

It is chiefly to his wonderful brain that man owes his infinite superiority over all other classes of animals. It is also the brain that gives man personality and character. A man's value, his ability to accomplish things, and therefore his usefulness, depend upon his brain. A boy may lose his leg or arm and yet have a useful life before him; but when the brain is undeveloped or diseased, as in idiocy or insanity, the individual becomes useless and a burden to society. All the other organs of the body are the servants of the brain, which is the master organ.

The chief organ of the body

The wonderful structure and function of the brain have been discovered by the aid of many interesting experiments. Professor Horsley, in order to study the work of the different parts of the brain, made some experiments which have been of great value to physicians and surgeons in the treatment of diseases of the brain. He removed a small portion of the skull of a monkey, making a window through which he could see its brain, which very closely resembles the human

brain. He found that when he touched a particular part of the exposed brain with a little electrical instrument, the monkey made a grimace, — he had touched that part of the brain that controls the movements of the face. When he touched another spot, the monkey's



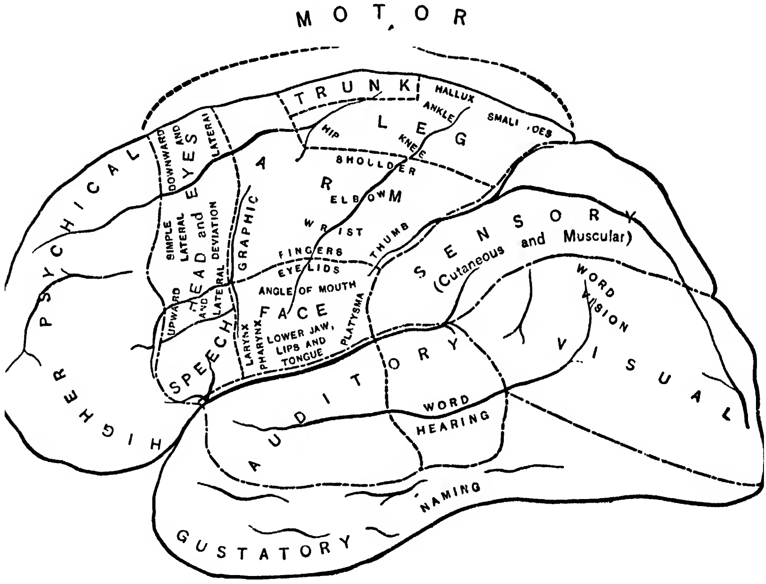
A GENERAL VIEW OF THE WAY THE BRAIN IS DIVIDED INTO "CENTERS" FOR SPECIAL KINDS OF WORK. WE ARE LOOKING AT THE LEFT HEMISPHERE. THE RIGHT HEMISPHERE HAS CORRESPONDING DIVISIONS.

arm was pulled up. Touching still another spot caused the leg to be drawn up. It was found that each group of muscles was controlled by a different part of the brain; each had its own particular "center" controlling its movements.

In this respect the brain is like a keyboard. You get special results according to the key that is struck,

just as in a piano you get a different note from each different key. Or it has been compared to an electrical switchboard, connected with machines of various kinds. By touching one key an engine may be set in motion for grinding corn; another key starts an engine sawing wood;

The "centers" in the brain.



A LATERAL SURFACE OF THE BRAIN SHOWING THE CENTERS OF CONTROL.

another may cause the lighting up of a town. The power in each case is the same, the difference in the result is due to the difference in the connections.

The speech-controlling center is on the left side of the brain. If this part of the brain is injured, one loses

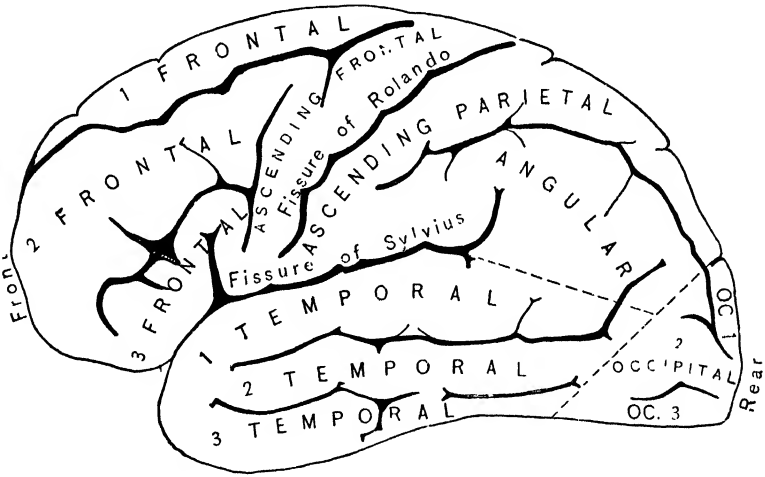
the power of speech. He can think as well as ever but can not express his thoughts in language. We have also a word-seeing center, and if this is injured or diseased, "word-blindness" is the result. One suffering in this way can see objects as well as ever, because there is nothing wrong with the eye. He can see trees, houses, men, and can even see the marks on the page of a book, but the letters have no meaning to him, any more than Chinese characters would have to you. There is also a "word-hearing" center, with which we learn spoken language, and when this is diseased or injured "word-deafness" results. A person in this condition can hear music, whistles, the songs of birds, he can even hear the sound of words, but they convey no meaning to him, just as the noise of a Chinaman's talking would convey no meaning to you. We have also another center that has control of writing, and a person in whom this center is injured loses the ability to write.

These few examples help us to understand something of the marvelous complexity of the human brain. You know that the more complex a machine is, the greater the possibility of something's going wrong with it. A textbook published not long ago mentions one hundred and seventy-six diseases of the nervous system. One reason why there is so large a number of such diseases is that the work of the nervous system is so varied. And the demands of modern life are so great that new diseases of the nervous system are appearing. Diseases of the brain are increasing at such a rapid rate

that in some of the states at the present time one in every three hundred of the population is insane.

The seat of the mental faculties.

The cortex, that is, the outer covering of the cerebrum or large brain, the part that contains what is known as the gray matter, is the seat of the intelligence, that is, of the mental faculties. Its surface is roughened, being made up of folds, or convolutions, and depressions which are called *fissures*. The purpose of this seems to be to



SIDE-VIEW OF THE BRAIN SHOWING THE PRINCIPAL CONVOLUTIONS.

increase the surface area of the brain. If the brain were spread out on a level surface, it would cover a much larger space than you might suppose. Some of these fissures are so deep that they divide the brain into *lobes*, — the frontal lobes in front, the parietal and temporal

lobes on the sides, and the occipital lobes behind. Separating the frontal from the parietal lobes is what is called the fissure of Orlando, and about this fissure the motor area, the center that controls the muscles, is situated. The upper third of this area controls the movements of the legs and trunk; the middle third, the movements of the arms; and the lower third, the movements of the face and tongue. You will remember that the right side of the body is controlled by the left side of the brain, and *vice versa*. When, therefore, there is injury to the right side of the brain, the paralysis that results is on the left side of the body.

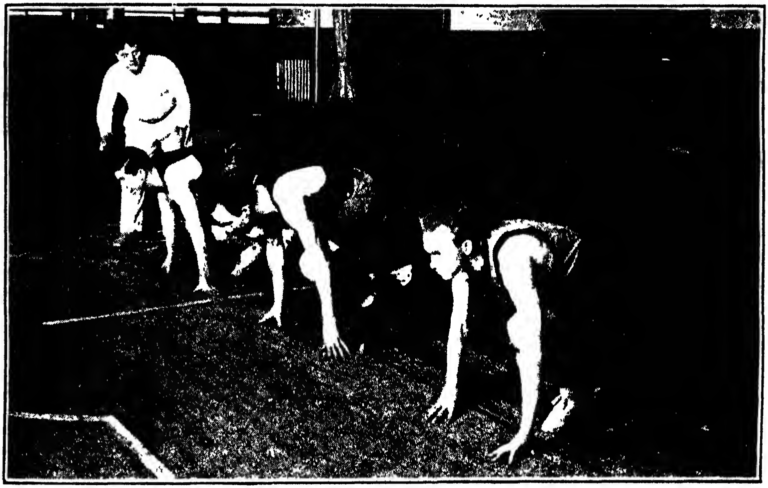
Action and reaction.

It takes about one tenth of a second to see a card when it is suddenly put before the eye and to indicate, by touching an electric button, that you have seen it. It takes about the same time to hear a sound or to feel the prick of a pin and to indicate it in the same way. We shall have occasion to notice, as we go on, some of the things that influence the time it takes to act when one hears, sees, or feels a thing.

Experiments have shown that it takes longer to act with the foot than with the hand, and longer still with the whole body, as in the starting of a race. The "reaction" time is shorter when the attention is held upon the signal to be given. When you watch the starting of a race you notice how intensely the racers concentrate their attention upon the signal to be given.

They seem to be listening with their whole bodies, with every muscle alert to respond. They know that the closer the attention, the quicker start they are likely to make.

These things that we have been considering help us to see how all the work of the body, depending as it does



NOTE HOW THESE RACERS CONCENTRATE THEIR ATTENTION SO THEY CAN REACT QUICKLY UPON THE STARTING SIGNAL.

upon the nervous system, will be influenced by anything that affects the nerves. Not only can one whose brain is clouded or whose nerves are benumbed by poisons circulating in the blood, not think clearly, but all the work of the body is more or less hindered. Such a person can not use his will power as he should to make quick decisions and to carry them out promptly;

moreover, his judgment will be clouded, and he will be likely to make mistakes.

Habits.

Think of the many muscular movements involved in turning a somersault. If the acrobat or athlete had to think of each consecutive movement, he would probably land with a broken neck instead of in safety on his feet. In the beginning, of course, he has to do this, but then care is taken to have a soft landing place or to direct the motion with the teacher's arm, and so prevent injury. Yet when any form of exercise has been thoroughly learned and practiced, all that is necessary is for the first step to be taken, and all the rest will follow in their natural order without thought. One who has mastered the art of swimming, although he may for years be deprived of the opportunity to swim and may even think he has quite forgotten the movements, when he finds himself in the water can swim easily without any thought of the movements required.

The story is told of an old soldier who, having retired from the army and taken up another occupation, was walking along to his work carrying his dinner pail when some one suddenly called out to him the signal for standing "at attention." Instantly the dinner pail was dropped and the body was drawn up with the heels together and the arms straightened at the sides in the attitude of attention. The habit worked before the mind had time to prevent it.

We see, then, that what we at first do knowingly,

will, if we do it often enough, be done for us in the same way without our thinking about it, without our choice, and even in spite of our will power. This shows us the importance of doing things from the start in the right or the best way, so that they will not for the rest of our lives keep "doing themselves" in the wrong way. A psychologist has said that we are all mere "bundles of habits." That is, our character is the sum of our habits, physical, mental, and moral. Was he right? Why?

The influence of the mind on the muscles.

In the learning of any new act, the mind must be kept on the details of the work, as in typewriting and piano-playing. As a general thing, the progress made will be in proportion to the *concentration of the mind* on the work. Some one has said that "almost any one can do any thing that he desires to do if he desires it strongly enough and sticks to it long enough to whip the muscles into the habit of carrying out the wish."

The influence of the mind over the muscles has been strikingly shown in some Yale experiments, which showed that men who even only watched others exercise, without taking part themselves, increased the size and strength of the muscles used by the others. When one thinks of an action, the muscles at once begin to contract as though to perform it. If you are greatly interested in a contest of any kind, and especially if a friend of yours is taking part, how you will work with him! When he throws the ball your own

hands start working. When the high jump is made you seem to lift your own feet. It is said that among the enthusiastic throngs at football matches it is not uncommon for some one in the crowd to receive a violent kick from an onlooker behind him, when one of the players is kicking the ball.

In view of these facts, what effect do you think that interest and enthusiasm in your work would be likely to have upon your progress?

The effects of nerve fatigue on the muscles.

Dr. Mosso, an Italian, invented a machine called an *ergograph*. He used this for the purpose of testing the effects of nerve fatigue on the muscles. The ergograph held the hand and wrist firm, leaving the middle finger free for use. To this finger was fastened a string which at the other end was attached to a six and a half pound weight. The finger had to raise this weight every two seconds and continue this as long as possible. For every pull made by the finger, a pencil attached to the string drew a separate line. These marks showed the height to which the weight was raised as well as the number of times it was raised. Dr. Mosso made numerous tests under all sorts of conditions, and one of the things he discovered was that the subjects tested were not able to lift the weight nearly so many times after they had been doing hard brain work for a long time. For instance, a professor in the University of Turin, to which Professor Mosso belonged, was tested one afternoon just before giving oral examinations to

his pupils, and again when the examinations were over, after three and one half hours of mental effort. Although he had done no work with his hands during this time, the muscular power of his finger was greatly decreased. All of the tests made showed that hard brain work affects the muscles and lessens their power for work. Can you think of any reasons why this should be so? The muscles are controlled by the nerves and, when the nerves are exhausted, they can not get so much work out of the muscles. In view of this, do you think it is a good thing to try to do hard muscular work or to take vigorous exercise when you have been doing hard brain work for a long time?

The effects of muscular fatigue on the brain.

Dr. Mosso also wanted to find out, on the other hand, the effects of muscular fatigue on the brain. He did this by means of experiments with birds. He had some trained pigeons, some of which he took to a distant city and set free. When they arrived home he examined their brains. He found that while the brains of the pigeons which had remained at home were full of red blood, the brains of the exhausted pigeons were quite pale, as though they contained no blood. Where had the blood gone? An examination of the wing muscles showed that they were much darker color then those of the pigeons which had been resting, and that all the blood vessels in them were congested with blood.

When there is an increased supply of blood to any part of the body there is not, of course, an actual in-

crease in the amount of blood in the body, but the blood is withdrawn from some other part where it is not so much needed at the time. During severe muscular work, the blood is drawn to the working muscles and the supply to the brain is lessened. Do you think that such a time is a good time to try to do hard brain work?

It is important also to know that after eating there is an increased blood supply to the digestive organs, which lessens the supply to the brain. This explains the mental dullness and drowsiness which are a common experience with some people after dinner, especially those who are inclined to eat too much. Do you think this is a good time to try to draw an extra supply to the brain for mental work?

Can you think of any other way in which the brain and nerves are affected by muscular work? Recall what you have learned about the fatigue poisons formed in the muscles and their effects upon the whole body. When a person feels tired it is because he is poisoned by his own waste products. But the body is so marvelously constructed that it is able to purify itself, like a running stream, by means of the circulation of the blood. Rest gives opportunity for this purifying process, and so counteracts or overcomes fatigue.

All these things show us that what is needed after hard work of any kind, either muscular or mental, is *rest*. Rest is needed (1) to equalize the circulation of the blood, (2) to give time for the washing out of the fatigue poisons, and (3) to give the nerve cells a chance

to recover, before new work is undertaken. Both mental and muscular exertion are beneficial and not harmful, if only the proper balance is kept between work and rest. A period of work needs a corresponding period of rest. A short period of work calls for only a short period of rest, but when the working periods are longer the resting periods need to be longer also. Experiments with bricklayers and other workmen recently showed that more work was actually accomplished when the day was divided up into short periods of work and rest than when the whole day was spent in work. Why, do you think?

There is something else besides rest which greatly assists the body in purifying itself and so overcoming fatigue. One of the professors in the Turin University where Dr. Mosso made his experiments tested his finger with the ergograph one day, and the next day he tested it again after massaging the finger thoroughly for three minutes. This experiment, many times repeated, showed that the muscles were able to do twice as much work after massage as they were capable of before it. One day he tested his finger after a ten-mile walk and found that he was able to do only one quarter as much work with it as before he started. But when his hands and arms had been massaged for ten minutes, he could do as much as before he went for the walk. He estimated that two hours of rest would have been necessary to accomplish this result; so massage had done for him in this respect in ten minutes what rest would have

done in two hours. Massage benefits the nervous system by increasing the circulation of the blood and hastening the removal of the toxins or poisons.

Health Problems

1. Have you ever seen the brains of a calf or other animal? Describe them.

2. Find out how a telephone switchboard operates, and tell how the working of the brain may be compared to it.

3. Do you know any persons who are partially paralyzed? What has caused their condition?

4. Have you been at the fire station when an alarm of fire came in? How did the firemen and even the horses respond to the signal? What has made them so prompt?

5. How long do you think it takes you to withdraw your hand when you touch something very hot? Does your foot respond as quickly? Why?

6. Watch a young child who is learning to write. Describe his appearance and his actions. What kind of muscular action is he performing? Is it the same with the teacher who has had long practice? Explain.

7. Make a list of actions which were once voluntary for you and which have become automatic, or habitual. Explain how such changes are made.

8. Would a person who took gymnastic exercises unwillingly derive as much benefit as a person who took them with interest and enthusiasm? Why?

9. When a person is ill because of poisons circulating in his body, how does his brain act? Does he think quickly and respond readily? Why? Mention a case to illustrate this.

10. Do you find it as easy to study in the evening as in the morning? Why? Do you think children can make as much progress at night school as at day school? Why?

11. Can you mention other ways of resting the body besides sleeping?

Review Questions

1. Why is the brain called the "master organ"?
2. Have you ever known any one whose mind was diseased? How did he act?
3. Tell about the experiment with the monkey's brain.
4. How is voluntary movement of the body caused?
5. Describe the brain.
6. What is meant by *reaction?* How quickly does the average person react to a signal?
7. What things influence the length of reaction time? What effect have poisons circulating in the blood upon this?
8. What is reflex action? Give examples.
9. What is the importance of forming good habits?
10. How were the muscles of the men at Yale who simply watched some gymnastic exercises with interest affected?
11. Of what importance is one's mental attitude in any work? Give examples of this.
12. Describe Dr. Mosso's experiment to show the effects of nerve fatigue on the muscles.
13. Why should tired nerves mean lessened muscular power?
14. When a person has been doing very hard brain work, should he attempt to do muscular work? Why?
15. What was noticed in the brains of the pigeons who had been flying all day?
16. What does this prove about the effect of tired muscles on brain work?
17. Why is one dull and drowsy after a heavy meal? Should one study immediately after a meal?
18. What is the real cause of weariness?
19. What three things does rest do for the body?
20. Of what value is massage? Why?

CHAPTER VIII

The Mental Faculties

We have seen that muscles and nerves that remain inactive shrink and lose their strength. In the same way an idle brain becomes less and less capable of good sound work, which means *thinking*. It frequently happens that students of only moderate talents become by means of mental labor, men of power, while highly gifted young men who cease to exercise the brain and spend their time in idleness become narrow-minded and often stupid. Mental work preserves and strengthens the brain instead of wearing it out. This is shown by the fact that the great thinkers and brain workers of the world usually reach advanced age with their mental faculties clear and strong, while those whose brains have had little exercise are much more likely to become feeble-minded in old age.

Attention and interest.

To achieve anything worth while in study one must concentrate upon the thing to be understood or learned, and everything not connected with the task in hand must be shut out of the mind so far as possible. In hydraulic mining the flow of water used would be worthless if spread out in fine spray over the face of the hill to be washed down. But

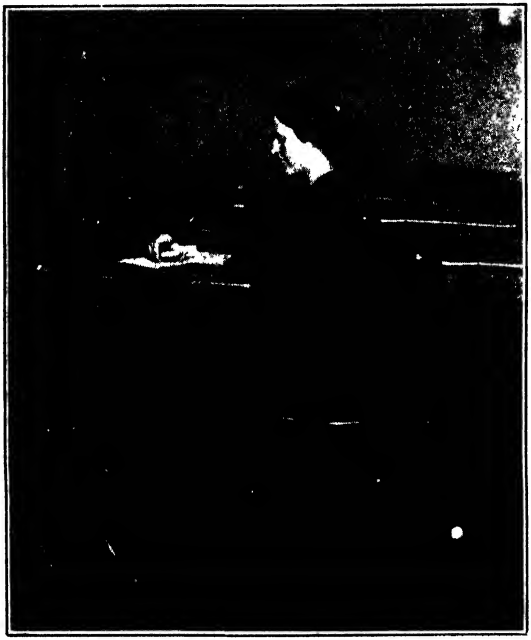
concentrated in a small stream its power is very great, tearing away earth and rock, and overcoming all obstacles. So with the mind: much more is accomplished when one gains control of his whole mental force and directs it upon the task before him.

How much more clearly a thing is impressed upon the mind when the attention is directed to it is shown in

IN HYDRAULIC MINING, HILLS CAN BE WASHED AWAY, BECAUSE OF THE FORCE OF THE CONCENTRATED STREAMS OF WATER. WONDERS CAN BE ACCOMPLISHED WHEN THE MENTAL POWERS ARE CONCENTRATED ON PROBLEMS.

what are called "puzzle pictures." You see, for instance, a landscape with a huntsman in it, and you are told to "find the fox." When you first look at the picture the landscape and the hunter stand out clear and distinct, but the fox is nowhere to be seen. But when you have discovered the fox it seems to stand out so distinctly that you wonder you did not see it at once. Besides this, the picture which before stood out so

clearly now drops into the background and is hardly noticeable while youı attention is directed to the fox. Or you may get the same effect in a different way by fixing your attention upon one instrument in an orchestra. That one is then heard clearly and distinctly and seems to stand out from all the rest.



THIS PUPIL KNOWS HOW TO CONCENTRATE HER MIND ON HER WORK, AND SHE NEVER FAILS.

Concentration of the mind on one thing shuts out other things. The great thinkers of the world have possessed in a high degree this power of concentration,—of shutting out of their minds everything but the subject of study. In Sir Isaac Newton, who greatly enriched the world by his wonderful discoveries, this power of concentration was so great that he often did not know whether he had dined or not.

What is it that holds the attention in this way? It is *interest*. You know that when you are reading a story that greatly *interests* you, you become so absorbed in it that you are quite unaware of all that is taking place around you. There is never any difficulty in getting any one to pay attention to a thing that interests him. Students sometimes find it difficult to fix their attention on their studies because they are more interested in the things that are taking place around them. What do you think is likely to be the result if the student permits picture after picture of everything that takes place within the range of his eyes and ears to be impressed upon his mind?

The effect of certain things in preventing concentration of attention has been determined by means of experiments. Noise or confusion in the room in which the tests were being made was a source of distraction. Even the playing of a musical instrument in the room was found to have this effect. When one is weary it is much more difficult to fix the attention, and consequently the mental image is not so clear, and whatever one is learning is much more likely to be forgotten under such conditions.

Mental activity a safeguard.

Thousands of people fall into evil ways simply for want of wholesome mental occupation. An unoccupied mind is like a stagnant pool, the water of which grows slimy and impure. Turn a lively brook into a pond covered with green slime and send the water dancing over the pebbles, whirling in

a thousand eddies and dashing over little waterfalls, and soon it becomes pure. If you wish to be free from unwholesome thoughts and to develop a character that will prompt to good and useful acts, fill the mind with useful truths and facts and keep it occupied. A boy who had passed through several reform schools and could not be retained in any because of his evil ways was about to be sent as a hopeless case to the asylum for the criminally insane. The drawing master in the school in which he then was, noticed that be began to show an interest in drawing, so he asked the authorities to wait a little while and see what this interest would do for the boy. With the special help of the master the boy made rapid progress and concentrated his mind on becoming an artist. From that time there was no further trouble with him, and he developed into a useful citizen.

The effect of thinking on the brain.

In order to test the effects of thinking upon the circulation of the blood, Dr. Mosso invented a machine with a balancing table or plank, by means of which he could test the weight of the brain under different conditions. When a person lying on this table begins to think hard the head part dips down a little, showing that the head has become heavier. The harder he thinks, as for instance in working out a difficult mathematical problem, the heavier his brain becomes. What do you think is the reason for this? You remember what takes place in a working muscle; there is an increased amount of blood

sent to it to supply the energy for the work. The same thing takes place in the brain. What should you expect to be the position of the balancing board when the person lying on it is asleep? The blood then recedes from the brain, and the head, becoming lighter, goes up and the feet go down.

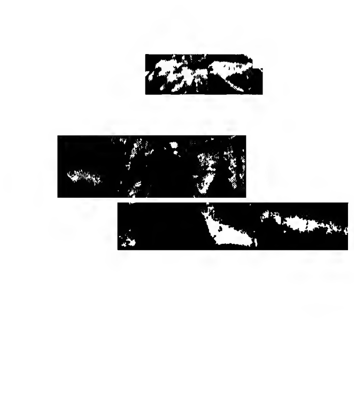
Good nerves and brain depend upon good blood.

Since the brain and nerves get all their energy, their working power, from the blood, you can see that the quality of the brain work must depend in some degree upon the quality of the blood. Anything that impoverishes the blood or makes it impure will affect the nervous system and make it impossible for the brain to do the best work of which it is capable. Alcohol and tobacco, and the toxins or poisons formed in the body when present in the blood in excess, may have an irritating or paralyzing effect upon the nerve cells. This explains the irritability, the despondency, the indecision, and even the moral depravity which are sometimes developed in persons whom one would least expect to exhibit such bad traits. Also eating too much and indigestion may produce giddiness, inability to think, and mental confusion.

A distinguished man of science has said: "When we think, it is not alone the mind that thinks, it is the whole man, and the process begins with the body. . . . The bodily condition strikes through and shows itself in the quality of the thought. The body lies at the base of success in all respects."

The emotions and their effects upon the body.

When we speak of the emotions, we generally refer to joy, courage, anger, fear, sorrow, and so on. The influence of these states of mind may be seen upon our own bodies at almost any moment. You can easily see that each of the emotions can be at once detected by its physical signs. If, for instance, you see a child laugh and clap his hands and skip about, you know that something has occurred to make him happy or joyful.



YOU KNOW THAT SOMETHING HAS OCCURRED TO MAKE HIM LAUGH.

Happiness benefits all the functions of the body by its influence upon the nerve centers that control the body. You know already of the effects of a happy state of mind upon the digestive organs, — how it increases the secretion of the digestive juices and helps along the work of digestion. The nerves that control the small blood vessels are affected in such a way that they cause the vessels to expand so that the blood may flow easily through them. Happiness also affects the nerves that control the heart so that it beats faster and sends the blood rapidly through the expanded vessels. This

results in increased nourishment to all the tissues. We often say that fat people are jovial, but perhaps we ought to reverse this and say that jovial people are fat; at any rate, they are more likely to be so than those who are unhappy. The brain also shares in the benefits of the increased allowance of blood, thus producing a flow of thought and of ideas and a quickness to form decisions and to carry them out.

A happy person feels light and springy and has a desire for motion, and this is why the happy child dances and claps its hands. A happy person has, if other things are equal, more endurance than an unhappy one.

> "A merry heart goes all the way;
> A sad one tires in half a day."

Laughter, as you might guess, has a distinct health value. It expands the chest and forces out the bad air from the least-used air cells at the apex of the lungs. It is also a healthful tonic for the stomach and liver, and so it aids digestion. It increases the circulation and so produces warmth.

You see that all the physical effects of happiness are healthful. So the things that help to make one happy, — love, trust, useful and congenial work, pleasant surroundings and associations, a contented mind, and such things, — are a help to the body. "A merry heart doeth good like a medicine."

The physical effects of sorrow or depression of mind

are, as we should expect, exactly the opposite to those of happiness. Its outward signs we see in the dull countenance and the slow movements which are due to its effects upon the muscular system. The free action of the diaphragm and the expansion of the chest are interfered with, as shown by the frequent sighing. The secretions are diminished, and this interferes with digestion. The heart beats slower and the blood does not circulate so well. The diminished blood supply to the brain shows itself in mental dullness and lassitude and in a lack of desire to do any mental work.

Emotions that weaken the body and the mind.

The physical signs of fear or terror are very apparent. The face is pale and the skin cold, because the blood is driven away from it by the contraction of the blood vessels in the skin. The sudden emptying of the skin of its blood is thought to be the cause of the rapid whitening or loss of hair as a result of extreme fright. An Italian physiologist, Mantegazza, vouches for the fact that the celebrated lion tamer, Faime, lost his hair the night following a struggle for life with a lion in its cage. The effects of fear upon the voluntary muscles may be such as completely to paralyze one and make him incapable of speech or motion. While the first effect of fear is usually increased activity of the heart, or palpitation, overwhelming terror seems to be able to stop the heart and so to produce sudden death. The secretions seem to be wholly arrested in a terrified person so that the mouth becomes dry and the tongue

cleaves to the palate. Fear is capable of producing long-continued and even incurable maladies. What do you think about deliberately frightening people as a "joke?"

An angry cat affords a striking example of the effects of anger or rage upon the body. Her back is elevated and every hair stands on end, until she seems to have swelled to twice her size. The effects of anger are just as apparent in the human being, though they are of a different nature. There is a rush of blood to the skin with redness and heat. The offended person "burns with anger," his "blood boils," we say, and he needs to "cool his wrath." The mucous membrane is so charged with blood that the eyes are red, and in some cases there is bleeding from the nose in a fit of passion. The blood vessels are enlarged, as can be seen in the neck and hands. Anger also expresses itself in strong and rapid motion, but the movements are very irregular. One may in these violent movements do himself injury without being aware of it. He may with no sensation of pain tear his hair or bite his lips until they bleed. In a desperate fight the combatants are sometimes unaware of injuries received, due to the abnormal condition of the nervous system.

It is particularly injurious to eat while angry. An angry person usually has no appetite. That rage has a poisonous effect upon the system is shown in the fact often quoted that after a violent fit of anger in a nursing mother the baby may go into convulsions, having been

poisoned by the milk. The babe is made sick because the milk is poisoned. The poison passes into the milk from the blood. The brain and every other organ is bathed with poisoned blood. So when a person becomes angry, he is poisoned. A frequent repetition of attacks of anger may lead to hardening of the arteries and high blood pressure.

You can now see the importance of cultivating for one's own sake as well as for the sake of others, the helpful emotions, — cheerfulness, contentment, courage and good temper, avoiding as far as possible the unhealthful states, — depression, anxiety, fear, anger, and hatred. This is just as important a law of health as any other that we have studied.

Health Problems

1. What would happen to a muscle if it were never used? What would happen to certain parts of the brain if they were never used?

2. In what kind of place do you like best to study? Why are whispering and making other noises forbidden in most schools?

3. Have you ever noticed how hard it is to study on a blustery day when the wind roars outside and the shades rattle within? Why is this?

4. What do you mean by *concentration?* Under what conditions can you concentrate most easily?

5. Perhaps you have noticed that you find it difficult to add long columns of figures if there are many people talking or moving about in the room; yet you have seen bookkeepers in busy, noisy offices adding readily and correctly without trouble. Explain how they can do this.

6. Describe Professor Mosso's method of weighing the effects

of work with the brain. What time of the day do you think your brain would be the heaviest? When the lightest?

7. Do you know any one who constantly takes poisons into his system or who habitually eats too much? Has he a happy disposition? A powerful mind?

8. Describe a person who is terrified. Should children ever be frightened as a joke or as a way to "make them mind"?

9. Describe a person when he is very angry. Describe him when he is happy.

10. Do you think one should let his thoughts dwell on illness and sorrow, or try to keep his mind on happiness and success? Why?

Review Questions

1. What is the best way to strengthen the mind?

2. What happens to even a brilliant mind that is not exercised?

3. Why is careless or indifferent study of no value?

4. What is meant by *cramming* for an examination? Is it a good practice? Why?

5. Explain the term *concentration*. Of what value is concentration in study?

6. Do you learn things in which you are interested more easily than things in which you are not? Why?

7. What effect does noise and confusion have upon the mind?

8. Why are busy, hard-working people seldom vicious?

9. Why is a person irritable and dull when his blood is impure?

10. Why does the brain weigh more when one is doing hard thinking than when he is asleep?

11. Explain the statement that "the body lies at the base of success."

12. What is the effect of sorrow on the body? of happiness? of fear? of anger?

13. Of what value is laughter?

14. What is said of the practice of angering or frightening a person "for the fun of it"?

CHAPTER IX

Deceiving the Nerves and the Mind

For centuries multitudes of people were accustomed to take alcohol under the impression that it increased their working capacity. They felt as though they were able to do more and better work after taking it. We have now come, however, to an age of science when people are no longer content with judging by feeling or appearance. In all departments of life exact knowledge, gained by means of accurate tests and experiments, is being substituted for mere guesswork. One of the things that has been most carefully and thoroughly tested by numerous scientists is the effect of alcohol upon the tissues of the body, and especially upon its efficiency. Is alcohol a help or a hindrance to body and mind?

One of the experimenters as to the effects of alcohol was Dr. Hodge. You already know something about the four dogs that were the subjects of his experiments. He came to the conclusion that alcohol has the effect of destroying courage, as well as lessening ambition and working capacity. Dr. Hodge says further that "In setting

Lessening courage, ambition, and working power.

type, adding figures, learning by rote, or doing any fine mechanical work, the man under the influence of even small doses of alcohol feels that he is working easily and rapidly—because his sense of fatigue and difficulty is paralyzed; but when measured and tested with scientific accuracy, his performances are always found to be slower and poorer in quality then when no alcohol is taken." What influence would such an effect be likely to have upon a person's career?

That alcohol has the same effect upon human beings as upon dogs in destroying energy and ambition, the characteristics that make for success, is shown in the observations of a German nerve specialist, Dr. Hugo Hoppe. Speaking of the "moderate" use of beer he says: "Thousands and tens of thousands who take their daily pint are rendered stupid, silly, and dissolute by beer. They will probably still transact regularly the daily business or routine of office to which they have become accustomed, but without special exertion, half automatically, like machines. For any further exertion, however, for improvement or for more productive activity, they lack the desire, the initiative, the energy." Do you think that such "machines" are likely to make much advancement? A lawyer who became President of the United States, William H. Taft, once said: "He who drinks is deliberately disqualifying himself for advancement. I refuse to take such a risk. I do not drink."

That alcohol does not increase but instead lessens

working power was observed years ago by Sir J. Ross, when he commanded an expedition to the Arctic regions. He noticed that he was able to stand the cold better than the officers or crew, although he was twenty years older than any of them, and he put this down to the fact that they used spirits and tobacco while he did not. After a time they had to abandon the ship and leave behind all the wines and spirits. Then they had, as he said, "the most irresistible proof of the value of abstinence. It was remarkable *how much stronger and more able the men were to do their work* when they had nothing but water to drink."

Alcohol lessens working capacity.

The same thing is seen in warm climates as well as in cold. Sven Hedin, the Asiatic explorer, says: "In a caravan a drop of wine or brandy should not be found. To be dependent on these things is a curse and especially objectionable on a journey which demands great exertion. The people, whether inside or outside the borders of civilization, who abstain from alcohol, are *the most competent and effective workers*."

In giving evidence before the Inter-departmental Committee on Physical Deterioration, Dr. Robert Jones said that alcohol "especially affects the motor system, and creates an enormous loss to the community by *destroying the productiveness of the skilled craftsman*." To determine the effects of alcohol in this respect Dr. Aschaffenburg carried on some experiments with skilled typesetters. One day they worked as

fast as they could for fifteen minutes and a record was made of the amount of work done. The next day they were given a little more than an ounce of alcohol a quarter of an hour before beginning work. Three out of the four men tested did less work after taking the alcohol than on the previous day. There was a difference of about ten per cent in the amount done. This would mean, of course, that they would earn ten per cent less on days when even such a small quantity of alcohol was taken, since their work was paid for by measurement.

How alcohol affects the judgment.

A strange thing about this experiment was that the men actually felt able to do more, and thought they were doing more, on the days when they had taken alcohol, when the actual fact was that they did considerably less. This shows us the deceiving effect of alcohol upon the mind. The powers by which judgments are formed are deadened, so that one is no longer capable of forming a correct opinion of his own acts. On this point Professor Sims Woodhead, of Cambridge University, says: "A man under the influence of small quantities of alcohol has *no right to believe his own senses.* He cannot trust them to give him correct facts, and he cannot rely upon his judgment for the interpretation of facts." Is such a man fit to hold a reliable position that calls for sound judgment?

Another thing noticeable in the experiment with the typesetters was that on the alcohol days they made

twenty-five per cent more mistakes than they did on the other days, a result which shows the effects of alcohol upon the ability to work accurately.

Some very important experiments on alcohol have been made by German investigators. In these tests the subject placed each hand upon a telegraph key, and one key or the other must be pressed promptly according as he saw a red or a white light. The subject had first to recognize the color of the light, then recall which hand was to act in response to that color, and then he had to act as promptly as possible. You can see that the conditions are much the same as when a locomotive engineer sees an unexpected signal light. When a glass of beer was drunk by the subject before these tests were made, "on the average the keys were released more rapidly than before the alcohol was taken, but *the wrong key* was much more frequently released than under normal conditions."

Some conclusive experiments.

A person under the influence of alcohol is likely to perform rash and hasty actions because the capacity to think clearly and to judge correctly is dulled or deadened. By paralyzing the higher centers of the brain alcohol allows a man to say and do things that his good judgment would prevent him from doing.

Ex-President Eliot of Harvard University tells the following little story showing the effects of alcohol on the quickness of action: "I had occasion to know about the time reaction of a famous pugilist whose habitual residence was not far from this spot. He was expecting

to fight in a city at some distance from Boston. The appointment was made, but he had been on a succession of sprees; his trainer could not control him; he was under the influence of alcohol a great part of the time. He was brought to Cambridge and his time reaction was tested. It was very slow. Now, this man had always been famous for the quickness of his time reaction. A pugilist has need to have a very short time reaction. He must see by the motion of his opponent's fist just where he is going to strike and put his own arm in the way quickly. A slow time reaction is fatal to a pugilist or fencer or runner. The effect of alcohol on the time reaction of the human being has been studied carefully, tested in hundreds of thousands of cases, and there is no question about the ill-effect of alcohol even in very moderate doses on the time reaction. That means that alcohol in very moderate doses diminishes the efficiency of the working man in most instances, makes him incapable of doing his best in the work of the day."

How long the effects of alcohol upon the working capacity last was shown by some experiments by Professor Furer. A person was tested for several days, at the same hour each day, as to reaction time, the association of ideas, the ability to memorize, and facility in adding. He was then allowed to drink two liters of beer in the course of a day. Outwardly this had no effect upon him, but the tests showed very marked effects in every particular. There was disturbance of all his faculties,

more difficulty in memorizing, and lessened facility in adding. These effects were seen not only on that day, but on succeeding days as well. It was not until the third day that the tests showed a complete restoration, although the subject himself felt no ill effects.

Since the effects of alcohol continue for a day or two after the day on which it is taken, what do you think must be the effect if it is taken *every day?* There is, of course, a piling up of its effects upon the mental powers and the working capacity. This was shown by some tests made by Dr. Emil Krapelin, Professor of Mental Diseases in the University of Munich. He tested some of the students without alcohol for six days, half an hour each day, as to their ability to add up figures. Then for twelve successive days alcohol was given to them. It was found that as a result of this their speed gradually lessened. They worked more and more slowly, until by the thirteenth day the working capacity of their minds was lessened by from twenty-five to forty per cent. That is, in some cases it was only a little more than half what it was when no alcohol was taken. But as soon as the students stopped taking alcohol, their work began to improve. Dr. Krapelin conducted a large number of very carefully planned experiments, making them over dozens of times so that his conclusions were determined with great certainty. In each case under the influence of alcohol the individual did less and poorer work. Although curiously enough in his half-intoxicated condition he

thought he was turning out more and better work than usual.

In view of all these things it would certainly be surprising if employers did not make a distinction between those who use alcohol and those who do not, and much prefer to employ the latter. Alcohol is becoming more and more of a handicap to a man in getting and keeping a position, as its effects upon the working capacity are becoming more widely known. Employers know that the man who dulls his brain and undermines his health by alcohol will do less work and be more likely to make mistakes than the man who does not drink. They dare not trust their business to such a man. Several years ago the United States Department of Labor found that already ninety per cent of railroads, seventy-nine per cent of manufactories, eighty-eight per cent of trades, and seventy-two per cent of farmers, discriminate against employees who use intoxicating liquor.

People who use alcohol not wanted.

Marshall Field and Co., of Chicago, not long ago expressed what is the attitude of most large business firms on this question, when they said, "Even though a man should apply for a position whose ability and other all-round qualifications would seem to fit him for the place, if we knew or discovered that he was a drinking man, we should decline to consider his application. Any man in our employ who acquires the habit of drink, even though moderately, is to a certain extent marked down in our estimation, and

unless we can remove from him this serious fault, and show him his error, we feel compelled to do without his services."

In these days a clerk, an engineer, a coachman, or even a gardener whose breath smells of alcohol or who is seen dropping into a saloon stands a good chance of losing his position.

A wealthy factory owner was endeavoring to close a saloon opposite his factory. The governor of the state asked him what was his reason for doing this. The reply was, "Governor, it's not a moral standard with me at all; it's economic. *My men are worth fifty per cent more* to me on Monday morning if that saloon is closed over Sunday."

Effects of alcohol on marksmanship.

Some tests have been made in Sweden with picked marksmen taken from among the soldiers, to find out if alcohol had any effect in increasing or decreasing their ability to shoot. It was found that in every instance the men did their best work — quickest firing and best hitting — when they had had no alcohol for several days. In his report the staff-surgeon said: "When under alcohol the result was thirty per cent less hits in quick fire, and the men always thought they were shooting faster, whilst actually they shot much more slowly."

This work especially demands steadiness of nerve, and alcohol, as you know, has a marked effect upon the nervous system. This is doubtless the reason why Emperor William of Germany has done so much

to discourage the use of it in his army and navy. When addressing the naval cadets in 1911 he said: "The next war and the next battle will demand sound nerves on your part. They will be decided by nerves. But these are undermined and endangered from youth upwards by indulgence in alcohol. . . . The nation which takes the smallest quantity of alcohol will win the battles of the future."

That the views expressed by Emperor William were deep convictions, the result of a careful and profound study of the question, is clearly shown by the fact that in the present great European war, alcohol is practically excluded. Until very recent times, the daily rations of the soldier included a certain quantity of rum or whisky. It was supposed to be necessary to fortify him against fatigue and hardships and to aid him on his tedious marches and especially to give him courage in battle. But now it is so well proven that alcohol can do none of these things, but does the very opposite instead, that alcohol not only is no longer served to soldiers in their rations, but every pains is taken to prevent soldiers from getting it.

In Russia, the manufacture and sale of alcohol is a government monopoly. At the outbreak of the war, the czar of Russia issued an edict prohibiting the manufacture or sale of vodka, the national alcoholic beverage, and so the whole Russian people including the army at once became a nation of abstainers. In France, the sale of absinthe has been stopped. England

supplies no alcohol to her soldiers and the government requests citizens not to "treat" soldiers when visiting their friends. The emperor of Germany sets his soldiers an example of total abstinence and insists that his soldiers must be sober. Some years ago the sale of liquor in the canteens of the United States army was prohibited and more recently an order was issued by the secretary of the navy, Mr. Josephus Daniels, excluding all alcoholic beverages from battleships and all other naval vessels. The fact that the present European war, the greatest military struggle the world has ever seen, is being fought without alcohol is the greatest victory the temperance cause has ever won.

Dr. Lorenz, the famous Austrian surgeon who was paid a great sum to come to this country to perform a single operation, said: "My success depends upon my brain being clear, my muscles firm and nerves steady. No one can take alcoholic liquor without blunting these physical powers which I must keep on edge. As a surgeon I must not drink."

Another famous surgeon, Sir Frederick Treves, said: "The best of physical condition is impossible if any alcohol is used. Its stimulating effects are only momentary, and after that the capacity for work falls enormously. No man is at his best who works on even a moderate amount of alcohol. Fine work can not be done under that condition."

All the new evidence with regard to alcohol shows that it is not a stimulant, as was formerly supposed,

but that its effects are benumbing and narcotic. Its supposed stimulating effect in removing the feeling of fatigue is really due to its putting to sleep the nerves that indicate fatigue. Fatigue is nature's way of telling us that the body requires rest. What the alcohol does is to make one unconscious of fatigue so that he tries to get more work out of an exhausted body.

Loss of time through sickness caused by alcohol.

The records of benefit societies in Australia show that in those societies that admit only abstainers the average time lost by the members through sickness is only a little over half as much as in those societies that admit drinkers. This you would, of course, expect when you consider all the effects of alcohol upon the body and the mind.

Alcohol causes the tissues of the body to degenerate in two ways. In what is called *fatty degeneration*, the living substance of the cell is gradually replaced by fat so that the organs are weakened and unable to do their work. The muscles of the heart and the kidneys and the liver may be affected in this way. In *fibroid degeneration*, there is an abnormal growth of connective tissue in the organs. This may take place in the muscular coat of the arteries, in the heart, and in the brain. Alcohol may cause heart disease, Bright's disease of the kidneys, hardening of the arteries and of the liver, and apoplexy, due to a rupture of a blood vessel in the brain.

There is another way in which alcohol causes sick-

ness, besides by these direct injuries to the tissues. We know that soldiers are much more efficient when kept without alcohol, and this is true of the little soldiers that defend the body against enemies, — the white blood cells. Professor Metchnikoff, who has told us most of what we know about the activities of these tiny cells, says: "Besides its harmful influence on the nervous system and other important parts of our body, alcohol exerts a damaging influence on the white blood cells, the agents of natural defense against infective microbes." Alcohol poisons these little soldiers and deadens or destroys their fighting power, so that they are easily conquered by disease-producing microbes. The result is that people who take alcohol are much more liable to infectious diseases such as pneumonia, tuberculosis, and typhoid fever than are abstainers.

You know that in acute diseases the chances of recovery depend very much upon the condition of the heart. A person with a heart weakened by alcohol is much more likely to succumb to disease than a person with a strong, sound heart. So you see that one who uses alcohol is as a general thing more likely to take disease and less likely to recover from it than one who does not. Death by violence or by accident is also more likely to overtake one who is under the influence of alcohol than one whose senses are keen and alert and his muscles steady. All these things being considered, you will not be surprised to learn that it is

estimated that *7500 of the 150,000 deaths* that take place in this country each year — about *one-twentieth* — are due either directly or indirectly to alcohol.

You will now understand why many life insurance companies are becoming strong temperance advocates and are doing all they can to instruct people as to the influence of the use of alcohol upon their chances for long life.

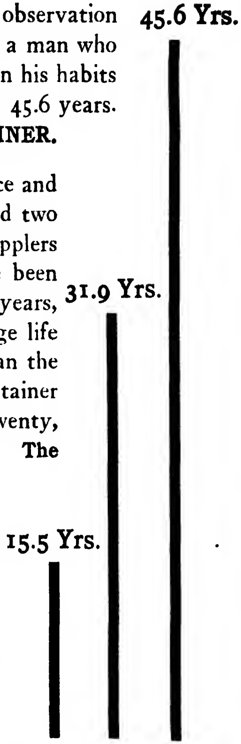
We can not better conclude our study of the effects of alcohol than by quoting the words of a well-known physician who has made a very careful study of this subject, Dr. Henry Smith Williams, addressed to users of alcohol: "I am bound to believe, in the light of what science has revealed (1) That you are threatening the physical structures of your stomach, your liver, your kidneys, your heart, your blood vessels, your nerves, your brain; (2) that you are decreasing your capacity for work in any field, be it physical, intellectual, or artistic; (3) that you are in some measure lowering the grade of your mind, dulling your higher æsthetic sense, and taking the finer edge off your morals; (4) that you are distinctly lessening your chances of maintaining health and attaining longevity; and (5) that you may be entailing upon your descendants yet unborn a burden of incalculable misery."

You will find the chart on the next page interesting and instructive. It shows what life insurance experts have found out about alcohol.

The Total Abstainer. The most painstaking observation on the part of life insurance experts shows that a man who is physically sound and in every way temperate in his habits at the age of twenty years may expect to live 45.6 years. **The long black line stands for the TOTAL ABSTAINER.**

The Tippler. The United Kingdom Temperance and General Provident Institution of London has had two classes of risks; first, total abstainers; second, tipplers or moderate drinkers. These two classes have been kept entirely distinct. During a period of 60 years, from 1841 to 1901, it was found that the average life of the tippler was nearly 30 per cent shorter than the life of the total abstainer. While the total abstainer lives an average of 45.6 years after the age of twenty, the tippler only lives an average of 31.9 years. **The middle line stands for the TIPPLER.**

The Drinker. Careful observation made by F. G. D. Nelson of London shows that men who are drinkers at twenty will only live an average of 15.5 years or one half as long as the moderate drinker and one third as long as the total abstainer. **The short black line stands for the DRINKER.**



Total abstainers live on an average nearly fourteen years longer than moderate drinkers.

This illustration shows the poor chance a drinker has for extended life as compared with a total abstainer.

Health Problems

1. If you know any drunkards, tell how the use of alcohol has affected their appearance, their strength, and their working powers.

2. How has it affected the happiness of their homes?

3. Men sometimes drink in very cold weather to warm

themselves. Are they really warmer after a drink of whisky? Explain.

4. In most mines, foremen will not permit men who have been drinking to go down the mine to work. Why is this?

5. Is there a juvenile court in your community? If so, find out what per cent of the offenders brought to court use alcohol.

6. What company in your community employs the most men? Find out whether they discriminate against users of alcohol.

7. Who is the best surgeon you know? Does he use alcohol?

8. Why do life insurance companies refuse to give a policy to hard drinkers?

9. When a person is very ill the doctor often asks whether or not he uses alcoholic drinks. Why do you think he does this?

10. People who use alcohol frequently have violent fits of anger and periods of great depression. What causes this?

11. Should you like to ride on a train if you knew that the engineer used alcohol? Why?

Review Questions

1. How has the opinion of people changed recently with regard to the effect of alcohol?

2. Tell about Doctor Hodge's experiments with dogs.

3. How does even a moderate use of alcohol affect the energy and ambition of a person?

4. Who are able to stand the cold in the Arctic regions best — people who use alcohol or those who do not?

5. How does alcohol affect a man's working power?

6. What is the effect of alcohol on people in warm climates or desert regions?

7. Tell about the test of the effect of alcohol on the work of the typesetters.

8. What effect has alcohol on the judgment? Why?

9. What did the experiments show as to the effect of alcohol on the promptness of a man's response to a signal?

10. How long does a drink of whisky affect a person's working capacity, even though he takes only a small quantity?

11. What is the result when a person uses alcohol every day?

12. Why do employers refuse to hire users of alcohol?

13. What effect did alcohol have on the ability of the Swedish marksmen?

14. When a tired person drinks alcohol, what happens to his nerves? Is he really rested and benefited?

15. What is *fatty degeneration?* How is it caused?

16. What is *fibroid degeneration?* What causes it?

17. Name several other diseases which may arise from the use of alcohol.

18. How does alcohol injure the white blood cells?

19. What five things did Doctor Henry S. Williams mention as resulting from the use of alcohol?

20. Has a drinker as good a chance for a long life as a total abstainer?

CHAPTER X

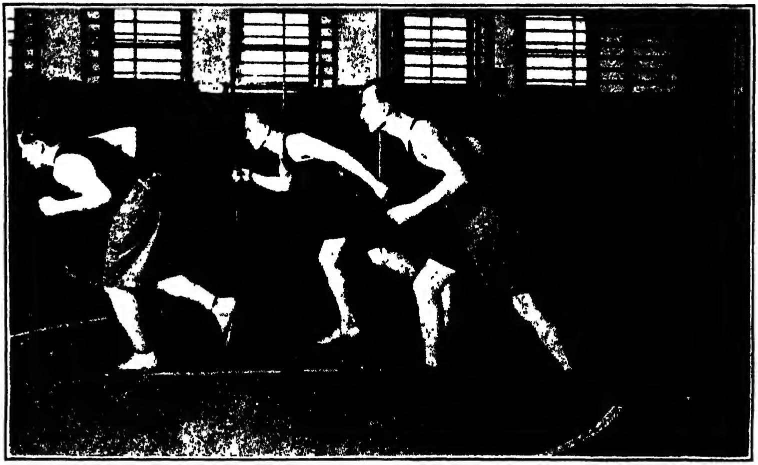
Handicaps in the Race of Life

Some years ago a bill was introduced into the House of Representatives of Japan prohibiting the use of tobacco by young people under twenty years of age. The Japanese statesman who introduced the bill said: "I should like to give you briefly the reasons why we have introduced this bill. Recently even children in our common schools have come to smoke cheap imported cigarettes, the consequences of which we fear may bring our country down to the miserable condition of countries like China and India; because tobacco, like opium, contains narcotic poisons which benumb the nervous system, and weaken the mental power of children addicted to smoking, and this gives a *death blow to the vitality of the nation.*"

The Japanese are a very patriotic people, always ready to sacrifice themselves for the glory of their nation or country. They saw that cigarette smoking by boys was threatening the nation's greatness, and so they forbade it. The effect upon the nation, of course, could come only through the effect of the cigarette poison upon the individuals who smoked it.

A cigarette smoking boy employed by a printing house often had to climb several flights of stairs in the course of his work. Many times before he reached the top he would find himself breathless, panting for air, with his heart beating furiously and his body trembling. The cigarette

A stone tied to one's neck.



Do you think the man handicapped by the ball and chain can win the race? Cigarette smoking is more of a handicap in the race of life.

poison in his system had reached that vital organ, the heart. A boy with "tobacco heart" can not keep up with modern industrial life, and this boy was soon discharged. His employer said: "No boy nowadays, when business is so strongly competitive, can afford to saddle himself with any destructive habit. It is like trying to swim with a stone tied to one's neck, or

race with a ball and chain at one's heels. A successful boy must be strong and healthy, and the tobacco-drenched boy is never that."

French scientists undertook experiments some time ago to find out the effects of tobacco in various forms upon animals. When a dog inhaled the smoke of tobacco the first effect was to cause a marked fall in blood pressure which was followed by a great rise. There was also contraction of the vessels of the kidneys and dilation of the vessels of the brain. The seriousness of the effects produced was in proportion to the amount of nicotine contained in the tobacco that was used.

Overtaxing the heart.

The same effects are produced upon human beings who inhale tobacco smoke. The high blood pressure produced by the contraction of the blood vessels forces upon the heart a great amount of extra work. Smokers are continually overtaxing their hearts in this way, with the result of wearing them out prematurely. Smokers often die of heart collapse or kidney disease because of the effects of tobacco upon these organs. The death of Mark Twain was caused by "tobacco heart." Surgeons have expressed the opinion that President McKinley might have recovered from his wound if he had not been handicapped by a "tobacco heart."

No one denies that tobacco is a poison to animals. The farmer uses it to kill the ticks on his sheep and the florist to destroy the green flies on his rose bushes. It will kill frogs, cats, and snakes. How can that

which to all other animals is a poison be anything other than a poison to man?

Smokers sometimes say that the poison is destroyed or escapes at the burning end of the cigar and is not to be found to any extent in the smoke inhaled. A German chemist investigated this matter and found that the smoke of a cigar contained half a grain of nicotine, an amount sufficient to kill a man if taken at a single dose. An habitual smoker does not die at once, but the effects accumulate and are likely to carry him off at last with heart failure or disease of the kidneys.

A little newsboy I know, when tempted by his companions to smoke and ridiculed because he will not join them in this vice, replies: "Do you think I am going to burn my brains out just because you do?" The effect of tobacco in "burning out the brains" is shown in the fact that *out of 2336 boy smokers, only six were reported as bright students.* The boy smoker is burning out not only his intellectual faculties, but his strength, manliness, courage, and steadiness, — in fact, all the qualities that he will need to make him a successful man.

Unsteady muscles and dull senses.

Professor Lombard of the University of Michigan has used the ergograph to find out the effects of tobacco upon the muscles. He found that on days on which he smoked five cigars his muscles lost about forty-one per cent — nearly half — of their working power. The steadiness and precision as well as the strength of the muscles are affected

by smoking, due to the effect of the tobacco poison on the nerves that control them.

A great engineer, when he was sending his students out into the world, gave them as his parting advice this motto: "Let your competitor smoke." By this he meant, if there is any smoking at all done, let it be done not by you but by your rival. Keep your own brain clear and your nerves steady, and thus you will increase your chances of winning life's prizes; while if your competitor smokes, that habit will lessen his chances of outstripping you. In this he was warning them that tobacco, like alcohol, is a handicap to success.

That your chances of winning are greatly increased if your competitor smokes is shown by the following instances related by Dr. Chas. B. Towns: "A great billiard player who never smoked assured me that he is sure of winning when his opponent is a smoker. A tennis player who smoked at twenty-one found that men whom he had formerly beaten with ease could now beat him. Riflemen know that they shoot better without tobacco, and even the average man who does not care to excel is susceptible to the repeated and continued doses of the various tobacco poisons."

Mr. Luther Burbank, who has been called the wizard of plant life, relates the following experience: "To assist me in my work of budding — work that is as accurate and exacting as watch-making — I have a force of some twenty men. I discharge men from this force at the first show of incompetency. Some time ago

my foreman asked me if I took pains to inquire into the habits of my men. On being answered in the negative, he surprised me by saying that the men I found unable to do the delicate work of budding invariably turned out to be smokers and drinkers. These men, while able to do the rough work of farming, call budding and other delicate work 'puttering' and have to give it up, owing to inability to concentrate their nerve force. *Even men who smoke one cigar a day* I cannot trust with some of my delicate work."

Is it surprising that employers refuse to employ a boy who smokes and would rather that their men did not? Forty-one business houses of Massachusetts signed an agreement to employ no one under eighteen years of age who smokes. Sixty-nine merchants of Detroit took the same pledge. Several of the largest Chicago firms have prohibited cigarette smoking among the boys in their employ. This is a warning to the boy who wants to succeed in the business world to let tobacco alone.

The worst effect of all.

But the worst effect of cigarette smoking by boys is seen not in destroying the brain power, making the nerves unsteady and unreliable, robbing the muscles of their strength, weakening the heart, and destroying the prospects of a successful career, but in the change that it makes in the character. You have already learned something of this — how the cigarette slave will lie and steal and commit almost any crime because the tobacco poison has deadened

or destroyed his moral sense. A doctor who has made a special study of the effects of tobacco upon boys in this respect says that when he hears of some dreadful and unnatural crime committed by a youth or a young man, he always expects to find that the criminal is addicted to the use of cigarettes, which usually proves to be the case.

In a recent murder trial, the judge said of the prisoner, "This young man smokes one pound of tobacco a week in the form of cigarettes. This is sufficient to derange any man's brain and produce insanity. It makes him irresponsible for the crime he has committed." The young man, however, was responsible for the thing that made him irresponsible — the cigarette smoking.

Similar testimony is given by "the Boys' Friend," Judge Ben B. Lindsey of the Juvenile Court of Colorado. He says: "I have been in the Juvenile Court nearly ten years, and in that time I have had to deal with thousands and thousands of boys who have disgraced themselves and their parents, and who have brought sorrow and misery into their lives; and I do not know of any one habit that is more responsible for the troubles of these boys than the vile cigarette habit. No pure-minded, honest, manly, brave, gentle boy will smoke cigarettes."

But perhaps we have not even yet got to the worst of the evil, which is that tobacco, is, like alcohol, *a race poison*. That is, it affects not only the person who smokes, but the evil is handed down to his descendants. It destroys his ability to have perfectly

healthy children. When a boy by smoking has crippled himself mentally and morally, if he grows up and marries, his children will in all probability be like himself, mental and moral cripples.

When tobacco gets the mastery over a man, it compels him to use his earnings for that which is worse than useless. A young man urged by another to smoke agreed to allow himself one five-cent cigar a day. But instead of smoking he saved the money, and at the end of six years it amounted to $109.50, which he expended for books that he called his "cigar library." Some one has reckoned: "One who begins smoking at ten years of age and smokes one five-cent cigar a day would, reckoning interest at six per cent, have paid out at the age of twenty-five over four hundred dollars; at fifty years twenty-seven hundred; and at seventy-five about eleven thousand and five hundred dollars. But suppose he smokes three five-cent cigars a day (which would be a limited allowance for most smokers). At twenty-five he would have smoked up thirteen hundred dollars, at fifty nearly nine thousand, and at seventy-five nearly forty-two thousand dollars."

A waste of money.

The health officers of Washington recently issued a letter of caution to parents urging them not to allow their children to use *tea and coffee* at home. They were of the opinion that the "nervousness" which is becoming so common among school children was due as a rule not to overstudy, but

Unsuspected handicaps.

as Dr. Wiley says, to the fact that "they are subjected to stimulants of various kinds, which have no food value and can work only injury. I refer especially to coffee and tea at home, and the indulgence by the boys and girls in the so-called soft drinks which contain cocain or caffein." Dr. Sadler, the great nerve specialist, says that coffee and tea are nerve poisons and are the cause of nervousness, worry, and other maladies.

Tea and coffee not only contain, as Dr. Wiley says, no food value, but they work injury because they contain a poisonous substance known as *theine* in tea and *caffein* in coffee. Taken in concentrated form and in comparatively small doses, these substances cause sickness and may even produce death.

An ounce of tea leaves contains from fifteen to thirty grains of this poison, an amount sufficient, if extracted and swallowed at one dose, to poison a person not accustomed to its use. An English officer on duty in Africa some years ago lost a fine horse by poisoning from tea which had become mingled with its food. A physician and his assistant, in conducting some experiments with coffee, were both rendered insensible by drinking a quantity made from two ounces of coffee beans.

Tea and coffee also contain *tannin*, which hinders the digestion and absorption of food. Sir Benjamin Ward Richardson says: "The extremely injurious effects of tea are best seen in some of those who are

charged with the commercial duty of 'tea tasting.' A professional tea-taster, who was so seriously affected that he thought it proper to consult me on the symptoms induced, defined the symptoms very clearly as follows: 'Deficiency of saliva, destruction of taste for food, biliousness, nausea, constipation, an extreme and undefinable nervousness, and nightmare whenever sleep is obtained!'"

Doctor Nesbit, a professor in a medical college in Philadelphia, established a poison squad for the purpose of testing the effects of caffein. The squad consisted of eight students to whom the caffein was given irregularly in such a way that they were ignorant of the time of its administration. All the students who took the caffein suffered from attacks of severe headache and nausea. One member of the squad at the end of twenty days became so ill that he had to be taken to the hospital, but he soon recovered when he took no more caffein.

Drugs which are capable of such effects when taken in large doses must certainly work some mischief when taken in small doses. The difference is that the large dose takes effect immediately, while the effects of the small dose, though not so apparent, pile up and undermine the health, appearing later in chronic disorders.

Mischief may come from small doses.

Another professor who experimented with caffein upon a great variety of persons noticed that when more than four grains were taken the caffein produced

nervousness, headaches, and irritability. An ordinary cup of coffee contains 2.5 grains. How many cups would it take to make up the dose which would produce these effects? We must remember also that it is not the fifth grain that does the mischief, it is the sum of all the grains that have been taken. Of this Dr. Wiley says: "How often do I hear the phrase, 'I can drink a strong cup of coffee with no ill effect.' The same excuse is urged for the use of alcoholic beverages. . . . It is not the fourth or fifth drink of whisky that intoxicates; it is the sum of the first, second, and third drinks."

Government statistics show that the average American takes six grains of caffein a day, enough for the effects to be immediately apparent in nervousness, headache, and irritability. And, as we have seen, even when taken in smaller doses the effects pile up and undermine the health. What should we think of bread or potatoes if taking an extra slice of bread or an extra potato was likely to produce poisonous effects?

Why do people continue to take these drugs? Because their first effect when taken in small doses is exhilarating, so that they appear to relieve fatigue and increase efficiency. They enable a person to get more work out of himself at the time, just as a whip will spur a tired horse to make further effort, although it puts nothing into him to supply the strength for that effort. The tired woman takes a cup of tea and

feels refreshed and able to do more work. But she is not rested. She feels rested when she is still actually tired. She makes the cup of tea a substitute for the rest she ought to have taken to allow for the renewal of the body. In this way she is laying the foundation for nervous exhaustion.

A violent brain stimulant.

Caffein is especially a brain excitant. Sometimes hard brain workers, especially those that have to work late at night, — editors, reporters, students before examination, — take coffee to enable them to get more work out of their tired brains. As the coffee wakes up the brain the whole nervous system shares in the exciting effect, and the person is quite likely to smoke to soothe the irritated nerves. Sooner or later this state of things results in a nervous, irritable condition, loss of weight, tremulousness, in short, in *neurasthenia*, a general derangement of the nervous system. This disease is sometimes called "Americanitis" because it is so common in this country. This doubtless has some relation to the fact that more coffee is consumed in the United States than in any other country. It is estimated that 25,000,000,000 cups of coffee, which means 62,500,000,000 grains of caffein, are consumed in the United States every year.

"I must have a cup of tea or coffee for my breakfast; without it I am good for nothing for the whole day," is an expression one often hears. The conclusion to be drawn from this is not that the tea or coffee is beneficial,

but the reverse. It classes tea and coffee with the injurious habit-forming drugs. The fact that one who uses these beverages finds himself nervous and uncomfortable without them, just as the alcohol toper is uncomfortable without his customary toddy, is additional evidence of their harmful effect. No such results follow the withdrawal of bread or potatoes.

The exciting effect of these beverages is especially injurious in the case of children, who need to rest normally when fatigued in order that their growth may not be hindered. For this reason parents who have themselves formed the habit of using tea and coffee often withhold them from their children. Some of these children, however, who are not allowed to drink tea and coffee at home, get the very same poison at the soda fountain, where beverages containing caffein are sold. Experts are agreed that caffein-bearing beverages taken upon an empty stomach are more injurious than the same amount of caffein would be consumed with meals. This is the reason why Dr. Wiley especially warns the boys and girls against the soft drinks containing this poison, especially the various "cola" drinks.

He says:

"My plea to the teachers of the nation is to join in the great work to banish from the menu of the child every single substance which hits the nerves, excites undue activity, or produces unnatural stimulation, and to substitute in its place a wholesome, nutritious,

plain, simple diet, which may enable the child to grow and become a healthy and valuable citizen."

Recently complaints were made to the police in Newark, New Jersey, by parents who said that their boys had become "cocaine fiends." The police investigated and discovered that three youths were tempting and threatening the children into inhaling the drug, which was sold to them in five and ten cent doses and paid for with pennies given to the children for candy. One little boy told how one of these youths had succeeded in forcing him to take the drug. "He told me," he said, "that it would make me big and strong; that I would be a fine fighter if I took it often, and would soon be able to lick any boy of my size in the school. He also said that I would have nice dreams about being a millionaire's son, and having everything I wanted." None of the children knew that it was cocaine that was being sold to them, to sell which without a license is forbidden by law.

A deadly enemy of the nerves and the mind.

The truth about cocaine, which is very different from the picture given to the children, is shown in the fact that there are over one hundred sanitariums in the country giving treatment for the victims of the use of such drugs. It is a fact, also, that "those using cocaine, morphine, and opium are short-lived, most of them dying within ten years after contracting the habit and after suffering untold misery of mind and body."

A great many people get the drug habit without knowing it through using patent medicines containing these poisons. The head of a wholesale drug house testified in court that samples of a certain catarrh cure were being given away in New York City for the purpose of creating an appetite for it and so increasing its sale. Patent nostrums offered for catarrh, colds, hay fever, and such diseases, usually contain some powerful drug which if repeatedly taken will create an appetite for it and enslave its victim.

Avoid patent medicines.

The principal object sought by the makers of most patent medicines is that they shall produce a quick and vigorous impression. The stimulating or narcotic effects of the drugs put into them for this purpose are mistaken by the patient for marked evidences of improvement. When the effect wears off, he repeats the dose and continually has to increase it in order to get the same effect, until he finds himself a slave to the drug habit.

The Chief of the Division of Drugs of the Bureau of Chemistry tells of a boy who contracted the cocaine habit through its use for the treatment of catarrh. It became quite impossible for the boy to resist the temptation to use the drug, which was frequently offered to him by dishonest dealers. To save his family from disgrace he asked that he might be sent to a country where cocaine could not be purchased, and he was sent to Germany.

Patent headache remedies are especially dangerous. When Dr. Wiley was Chief Chemist of the Department of Agriculture he said: "Hardly a day passes that I do not receive from some part of the country the report of a death from taking headache powders. Every *such preparation* sold contains large quantities of *either acetanilid, phenacetin, antipyrin* or *caffein, all* of which affect the heart more or less."

Even the babies are not safe from drugs, but are sometimes, through the ignorance of their mothers or nurses, especially exposed to them under the name of soothing sirups, or colic cures. It is well known that these "soothing" preparations contain opium, morphine, or chloroform. Nurses sometimes use them unknown to the mothers to quiet the babies and put them to sleep.

The majority of bottled patent medicines contain alcohol, some as much as twenty-eight per cent. Some people of strict temperance principles have innocently acquired the alcohol habit by the use of patent medicines.

Health Problems

1. Are there any cigarette smokers in your class? If so, are they good students? Are they as courageous as other boys who do not use tobacco?

2. Are there any laws in your community limiting or prohibiting the use of tobacco? If so, tell about them.

3. Most drinkers and tobacco users season their food very highly, smothering it in such condiments as salt, pepper, and catsup. Explain.

4. Tobacco users seldom have a keen sense of smell. Why is this?

5. What causes the trembling, unsteady hand of the habitual drinker or smoker?

6. In greenhouses florists use tobacco smoke to kill insects on plants. If the smoke is powerful enough to kill these insects, do you think it will leave the cells of the body unharmed?

7. Find out what pupils in your class use tea or coffee regularly. Are their nerves as strong as those of girls and boys who do not use these drinks?

8. What do you think of the practice of substituting a drink of tea or coffee for an hour of needed rest?

9. Can a drink which will make a tired person wakeful be a good one?

10. Do the newspapers in your community advertise "patent medicines"? Can these medicines cure the diseases for which they are taken?

Review Questions

1. Why was a bill introduced in the House of Representatives in Japan against the use of tobacco by persons under twenty years of age?

2. What is "tobacco heart"?

3. Tell about the effects of tobacco on animals.

4. Does it have the same effect on human beings?

5. How does tobacco affect a man's mental powers?

6. How does it affect his muscles?

7. Tell about Luther Burbank's experience with his workmen.

8. What is meant by a "moral cripple"? How does tobacco help to create "moral cripples"?

9. What did Dr. Wiley say caused the "nervousness" common among school children?

10. What poisonous substance is contained in coffee? In tea?

11. How are tea-tasters often affected by their work?

12. How did the caffein affect the poison squad who drank it?

13. Why does a cup of tea or coffee sometimes make one feel refreshed? Is this a good thing?

14. What is said about drinks containing cola?

15. Name some of the habit-forming drugs. What effect have they on the body?

16. Mention some patent medicines. What do they frequently contain? Why are these poisons put in the medicines?

17. Can such medicines really cure disease?

18. Why are soothing sirups and headache medicines especially dangerous?

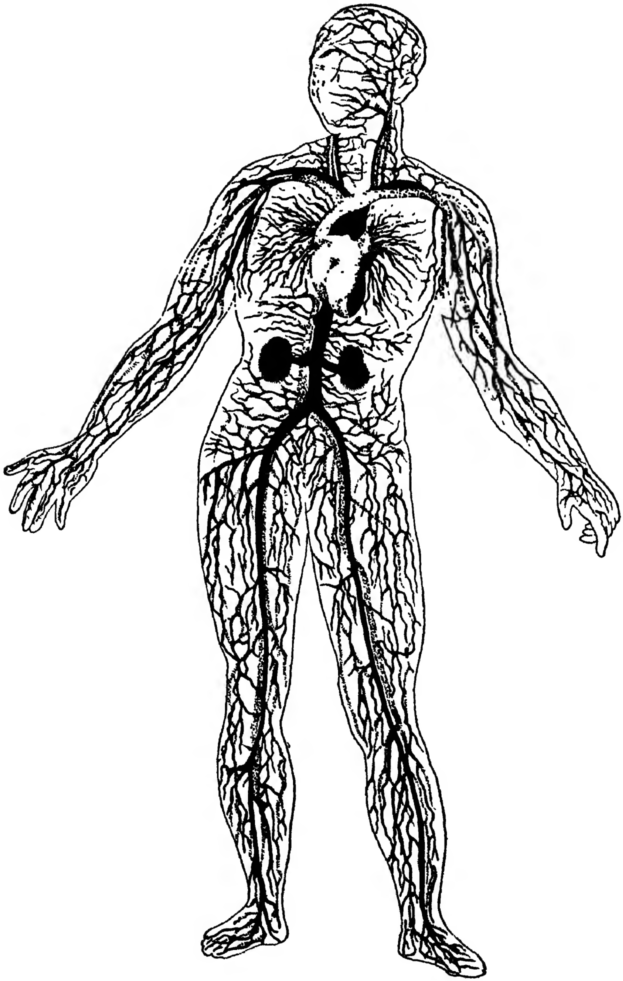
CHAPTER XI

The Body-Filters for Destroying Poisons

You probably know by this time that the body is a factory of poisons. Even in a healthy person living under perfectly right conditions, poisonous substances are constantly being formed by the wear and tear of the body. Besides this, poisons are constantly being developed by the decay of food in the alimentary canal. Bouchard, a distinguished French investigator, demonstrated that there is enough poison formed in the human body every twenty-four hours to cause death if it were not destroyed. Why do we not die of these body poisons? Because of the wonderful provision made by nature for their prompt removal by means of the eliminative organs.

The body filters.

The blood takes up the poisons from the various tissues and, as it circulates through the body, certain organs, which we might call the *body filters*, remove these injurious products, much as a filter removes the impurities from water. The circulation of the blood is arranged especially for this purpose. Do you remember the arrangement called the pulmonary circulation, by means of which the



THE CIRCULATION OF THE BLOOD. THE HEAVY BLACK LINES SHOW THE ARTERIES.

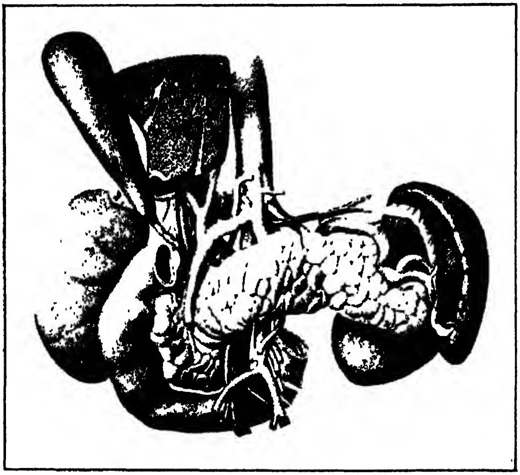
blood is sent from the heart into *the lungs*, where the *carbon dioxide* is removed and the blood is filled with oxygen before it is returned to the heart to be pumped through the body? Do you remember also the *portal* circulation, an arrangement by which all the blood supplied to the digestive organs — the stomach, intestines, pancreas, and spleen — passes through *the liver* before going *to the heart?* In this way all the materials absorbed during digestion are submitted to the inspection of the liver, which is another poison filter.

A wonderful and mysterious organ.

Aside from the brain, the liver is perhaps the most wonderful and mysterious organ in the body. It does many kinds of work. It secretes a fluid, it excretes poisons, it creates ferments, it destroys poisons, it digests and does other important work. It seems to be a sort of jack-of-all trades in the body, and yet its cells look all alike. The most powerful microscope can reveal no clew to its marvelous variety of activities. People have been known to live without a stomach, and with only one kidney, and with large portions of the intestinal canal removed. But if the liver were removed from a person, he would soon be fatally poisoned by the accumulation of the poisons which the liver excretes or destroys.

The power to destroy poisons is one of the most wonderful functions of the liver, by means of which it stands between us and death. If a person drinks water containing lead, or eats peas or pickles colored

with copper, the liver seizes upon the poisonous metal, and after discharging as much of it as possible through the *bile*, gathers the remainder up in its cells, thus preventing the passing on of the poison to the rest of the body. It is only when the power of the liver to expel or retain the poison has been exhausted that the harmful substance is allowed to pass on into the blood to injure the rest of the body.

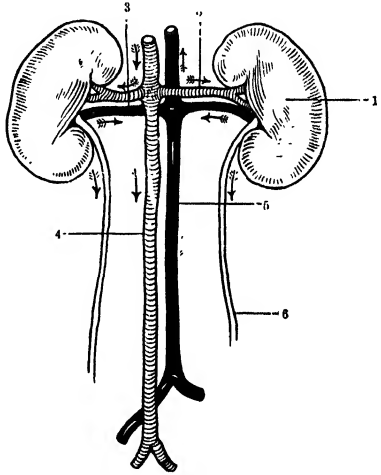


THE ORGANS OF EXCRETION.

Out of some of the waste materials that it abstracts from the blood, the liver makes the *bile*, producing from sixteen to twenty-four ounces every twenty-four hours. The bile serves a number of purposes. Besides assisting in the digestion of fats, it is an antiseptic and a laxative; that is, it hinders the growth of harmful germs in the alimentary canal, and it also encourages activity of the intestines. The bile is one of the most poisonous of the body wastes and needs to be removed from the system as speedily as possible.

This is one important reason why the bowels should move often, at least three times a day, or after each meal.

Waste substances produced by bodily activity are in part changed into *urea* by means of special ferments that are formed by the cells of the liver, and are in this way prepared for elimination from the body by another of the poison filters, *the kidneys*. The importance of the work of the kidneys in removing poisons is shown in the fact that if these organs are injured or crippled by disease so that they are no longer capable of filtering out the poisons from the blood, the person will pass into a state of insensibility (coma) which soon ends in death.



THE KIDNEYS.

1, kidneys; 2, renal cavity; 3, renal artery; 4, descending aorta; 5, ascending vena cava; 6, ureter.

When the body filters are impaired by disease, so that elimination is incomplete, or when poisons are taken in or produced in the body in overwhelming quantities, the result is *intoxication*, or poisoning.

The word "intoxication" brings to our minds a reeling drunkard; it makes us think of the saloon, the police station, wrecked homes, and ruined lives.

Alcoholic intoxication is, however, only one phase of its meaning. "Intoxicate" comes from the Latin word *toxicare*, and means really, "to poison." Now, it is a fact that a great many more people are poisoned or intoxicated by food than by strong drink. The poisons formed in the body if not promptly eliminated are just as capable of producing intoxication as are poisons taken into the body, such as alcohol. This kind of poisoning is called *auto-intoxication*, a word meaning *self-poisoning*.

Auto-intoxication, or self-poisoning.

The most common form of this kind of poisoning is what is called *intestinal intoxication*, — that is, self-poisoning with poisons that are absorbed from the intestine. How are these poisons produced? By germs, in the same way as poisons are produced in any decaying substance.

Pasteur, the French scientist, discovered that the intestinal tract is swarming with bacteria. Later investigators estimated the number produced in the intestine daily to be not less than 150,000,000,000,000, and doubtless the number is sometimes much greater. These germs may be divided into two classes — *fermentation* germs and *putrefaction* germs — which differ greatly in their characteristics and in the substances that they produce by their activity. *Fermentation* germs feed upon carbohydrates and produce acids that are practically harmless. The *putrefaction* germs feed upon proteins and produce toxins, some of which are almost as deadly as the venom of snakes. You

can see that the kind of germs that are most active in the intestine must depend chiefly upon the diet.

Normal human beings are born into the world entirely free from bacteria. Not a single germ is found in the interior of the new-born infant. Within a few hours after birth — four to six hours in summer and twenty hours in winter — the intestines of the infant are found to be swarming with bacteria of the harmless sort, the fermentation germs, or acid-formers. These acid-forming germs play a helpful rôle. Thanks to their action, the putrefaction germs can not thrive in the intestine, for these latter can not grow in acids.

One way to kill harmful germs.

Professor Metchnikoff, of whom you have already heard, in making investigations as to the causes of old age, observed that in the places where the most very old people were found, *sour milk* formed a large part of the diet of the people. In Bulgaria, for instance, a little country with only four million people, there are 3000 *centenarians*, or persons one hundred years old, or more. In other words, one in every 1300 of the population is over one hundred years of age. In this country, with a population of 100,000,000, we have only 4000 centenarians, — one in every 25,000. In Bulgaria there are nearly twenty times as many centenarians, in proportion to the population, as there are in the United States.

Sour milk, known under various names as "yaghourt," "matzoon," and "leben," is much used by the people

of Bulgaria and many parts of Asia and Africa. A man carrying pans of sour milk which he sells under the name of "matzoon" is a common sight in the streets of Constantinople. A similar sour milk preparation known as "skyr" is highly prized in Iceland. A fermented milk is used in India under the name of "dahi."

Sour milk contains the acid-forming fermentation germs whose activities prevent the decay of foods. If meat, which easily decays, is put into sour milk, it will keep indefinitely if the milk is changed every few days. This method of preserving meat is used in some countries. In the writer's laboratory is a piece of beefsteak which has in this way been kept in a perfect state of preservation for more than seven years. The lactic acid microbes have just the same effect inside the body, in the digestive tube, as they have outside of it. For this reason Professor Metchnikoff recommends the drinking of sour milk as a means of preventing intestinal putrefaction.

Another way to kill harmful germs.

Another way in which we can reduce the poison-forming microbes in the intestine is by regulating the diet so as to provide as little food for them as possible. The food of the putrefaction germ, as we have seen, is protein. Foods which contain no protein — for example, sugar — cannot putrefy. Meat and eggs, which are chiefly protein, readily putrefy. Vegetable substances are not likely to undergo this change because they contain but little protein. Besides this, Professor

Tissier, of the Pasteur Institute, has recently shown by experiments that animal protein, that is, meat, fish, and eggs, decays twice as readily as vegetable protein.

You can now see that a high-protein diet, especially when it consists largely of animal foods such as meat and eggs, is quite likely to cause disease. When more protein is eaten than can be easily digested, bacteria will grow in the undigested remnants, causing putrefaction. The toxins formed will be absorbed into the blood, and the whole body will be poisoned. A series of experiments have shown that, in persons living mainly on a flesh diet, the toxins formed in the intestine were four times as much as in persons living on a low-protein vegetable diet. It has also been shown by experiment that the kidney secretion frequently contains several times as much poison when a person is living largely on a flesh diet as when he is living on a low-protein diet. In such cases the work of the kidneys in abstracting the poisons from the blood is greatly increased, and they are, of course, more likely to become worn out and diseased.

The chief cause of self-poisoning.

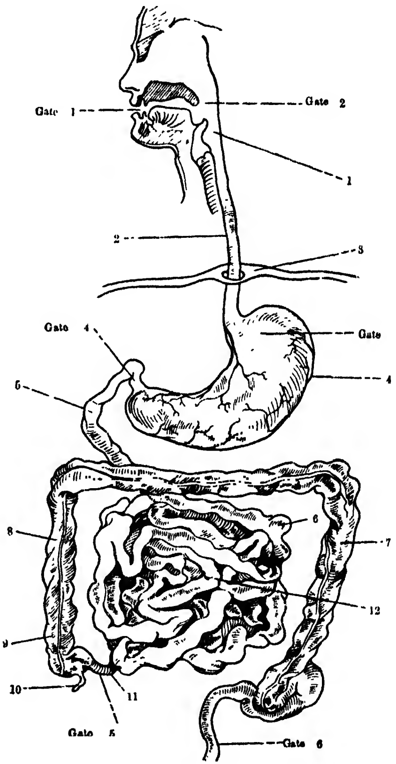
But perhaps the chief cause of self-poisoning is due to the retention of the poisonous decaying material in the colon (a part of the intestines), especially when this evil is combined with the high-protein diet. In such cases, the work of the eliminative organs is greatly increased to throw off the poisonous substances that ought to have been discharged through the bowels. Sick headache,

biliousness, a coated tongue, a sallow complexion, inability to concentrate the mind, irritability or depression, offensive breath and perspiration — these are some of the signs of this condition. If these warnings are not attended to, more serious conditions are likely to develop, — chronic diseases of the kidneys, liver, heart, and blood vessels, as a result of the poisons constantly circulating in the blood. A young person with sound liver and kidneys may be able to tolerate these poisons for a long time, though they will be constantly undermining his health. But when the marvelous poison-destroying machinery of the body becomes weakened or worn out by overwork, then these graver troubles appear. It is now well known that nearly all the changes in the body causing the so-called *chronic* diseases are caused by the absorption of poisons from the alimentary canal, especially from the

UNLESS THE INTESTINES ARE ACTIVE, THE PROGRESS OF DIGESTED MATERIAL IS RETARDED.

large intestine or colon — the last five feet of the food tube.

Until quite recently this part of the alimentary canal has been regarded as of little consequence, because its use is so largely that of a receptacle for unusable and waste matters, a sort of human garbage box. You know, however, what is likely to ensue when the garbage receptacle of a house is neglected. It becomes a breeding place for germs, and the health of the inhabitants of the house is likely to suffer. Modern investigators of this part of the intestine have shown that by neglect this receptacle for wastes may



COMPARE THE MOVEMENT OF THE FOOD ALONG THE ALIMENTARY CANAL WITH A RAILROAD TRAIN. NAME THE STATIONS.

dora's Box of miseries and maladies. So many and so serious are the troubles of mind and body which have been traced to it, that it has even been seriously suggested by

some scientists that the removal of the colon from the body would be a most desirable improvement.

There is a vast army of invalids throughout the country handicapped by chronic ills. Their efficiency is decreased and they are missing much of the joy of living. The only way to prevent or cure these chronic diseases is by proper habits of eating, drinking, breathing, exercise, and so on. Since so many of these ills are due, as we have seen, to the poisoning of the body from the contents of the intestine, it is a very important matter to attend to the cleanliness of the colon, reducing as much as possible the poison-forming microbes contained in it, (1) by a wholesome dietary; (2) by the proper regulation of the bowels. No matter what the diet may be, if the wastes are not promptly removed, toxins will be absorbed into the blood.

The digestion time table.

The movement of the food along the alimentary canal may be compared to that of a train of cars from station to station. By consulting a time-table, one may know just when a train is due. A physiologist has made a digestion time-table, which gives the time when the food eaten at a meal is due to arrive at certain stations in the alimentary canal.

TIME-TABLE FOR DIGESTION

Mouth (for mastication) . . .	$\frac{1}{2}$ hour
Stomach	$4\frac{1}{2}$ to 5 hours
Small intestines	4 to 9 hours
Colon (to fill and empty) . . .	9 to 18 hours

Of course the time depends upon the conditions under which the food is eaten.

By mixing bismuth with the food eaten it is now possible by means of X-ray examinations to trace the progress of the food through the tube, and find out if it is on time at the different stations, and if not, just where the delay is caused.

The kind and quantity of the food eaten influence to some degree, of course, the time necessary for digestion. But these figures, which are nearly correct, show that the wastes should be ready to pass out of the body in twelve to sixteen hours from the time the food is eaten. If they are then promptly removed, there is little opportunity for dangerous poisons to be formed. But when they are permitted to remain twenty-four hours, and even, as in some cases, for several days, the intestine may become a sort of obstructed sewer, flooding the body with nerve-paralyzing and disease-producing poisons.

The body, you must remember, is a sort of tube with an outside skin and an inside skin, and the latter is the lining of the alimentary canal. Many persons who would not think of allowing the outside skin to become filthy are not at all particular about the inside skin, perhaps because they can not see it. If the outside skin becomes dirty, much of the impurity is cast off in the perspiration and in other ways; but if the lining skin becomes dirty, the impurities are likely to be absorbed into the blood to poison the body.

Remember that the food is much more likely to arrive on time at the different stations when it has *bulk*, which stimulates the wall of the intestine and makes it more active. Fruits, vegetables, and salads are useful for this purpose, because of the indigestible cellulose they contain. Foods that are completely digested, leaving little or no remains, such as rice, boiled milk, bananas, potatoes, and fine flour bread, are constipating foods, simply because they do not leave sufficient indigestible residue to incite the intestine to action.

Things that encourage intestinal activity.

When the bowels do not move frequently and thoroughly, the colon becomes distended. It is overstretched in all directions so that it becomes too long as well as too large. Sometimes folds and "kinks" form, which greatly cripple the bowels and produce obstinate constipation. The overstretching also causes serious injury by destroying or rendering incompetent the ileocecal valve,—an interesting structure which Nature has placed at the lower end of the small intestine where it joins the colon, a check valve to prevent the filthy fecal matters of the colon from backing up into the small intestine. Examinations with the X-ray have shown that this condition is very common and a serious cause of sick headache, so-called biliousnes, and many other distressing ailments.

Exercise is another means by which the intestine is mechanically set into action. Vigorous exercise, especially that which causes bendings of the body and

movements of the legs, sets the diaphragm and abdominal muscles at work in such a way that between the two the intestines are vigorously kneaded and squeezed and thus stimulated to action. Deep breathing exercises and massage of the abdomen are also

BASKET BALL AND SIMILAR GAMES FURNISH FINE EXERCISE FOR ALL THE BODY, INCLUDING THE ABDOMINAL MUSCLES.

useful for this purpose. Drinking cold water, especially at bed time and the first thing in the morning, is another means of encouraging this intestinal action.

But the most powerful of all natural stimulants of the intestine is just *eating*, taking food into the stomach. Very soon after food enters the mouth a wave of action is started in the stomach and it passes along the entire

tube. X-ray examinations show that the intestinal contents move four times as fast during a meal as during the intervals between meals. Regular meal hours are necessary to produce regular bowel movements. Missing a meal interrupts the natural rhythm and is likely to cause the waste material to be retained too long. If a full meal can not be taken at mealtime, a little fruit or fruit juice should be taken for the benefit of the bowels.

Fasting not a good remedy.

Persons suffering from troubles caused by self-poisoning sometimes try to improve their condition by long fasting, — abstaining from food entirely for a long period. This is not a good remedy, for several reasons. When a person is fasting, the body does not actually go without food, but feeds on the fats and proteins of its own tissues. As a result of this high-protein diet an increased amount of toxins is formed in the body. Examinations made of fasting persons have shown that an unusual amount of poisons is being eliminated. Besides this, the natural arousing of the intestine furnished by the taking in of food does not take place, and so the bowels remain inactive. Yet bile is being formed, and poisonous matters are being given off as usual by the mucous membrane of the intestine; and it is necessary that these wastes should be removed. A better way to starve out the putrefaction germs is to confine the diet for a time to ripe, fresh fruit and green vegetables. This diet provides some nourishment,

gives sufficient bulk to stimulate the intestine to activity, and cleanses the alimentary canal: but it provides no food for the poison-forming microbes.

The "call" to bowel movement is like the call of the alarm clock set to awaken one in the morning. If not responded to, it soon ceases to be heard. It is like the voice of conscience, which may be wholly stifled by continued disregard. This is only working of a general law. A continuous sensation that is ignored by and by makes no impression. The first time a "call" is disregarded it may be heard again after the next meal or as the result of some other influence which sets up intestinal action. But after having been disregarded or resisted many times, the "call" becomes less and less distinct, until it may even cease to be heard at all, because the nerves charged with this duty have lost their sensibility. This loss is almost as bad as the loss of a fortune; indeed, a condition of constipation has more than once led to loss of fortune and to worse results.

Health Problems

1. Show why it is or is not right to speak of the kidneys as "body filters."

2. What do you think of when you hear the word "intoxicated"? Is a sick person really intoxicated? Why?

3. Do fermentation germs work on things outside the body? If so, mention what things.

4. How can you tell when putrefaction germs are at work on anything?

5. How old is the oldest person in your community? Find out something about his diet and habits of living.

6. Try the experiment of preserving a small piece of meat in sour milk, and report the result to the class.

7. Would you allow garbage to collect near your house until it became the breeding place of dangerous germs? Should a person be willing to let waste materials collect in his body in this way?

8. Read and tell the story of Pandora's Box. How may the colon become a veritable Pandora's Box of troubles?

9. What is your dinner time? Find out from the digestion table just when your food is due at different stations in the body.

10. Can a person be thought really clean unless his inside skin as well as his outside skin is clean? Mention some ways which help to keep the inside skin clean.

Review Questions

1. How are poisons constantly being formed in the body?

2. What is the pulmonary circulation?

3. What is the portal circulation?

4. Name the *poison filters* in the body.

5. What is the most wonderful organ in the body besides the brain? Why?

6. What is the most important function of the liver? Tell about how it performs this function.

7. What is the bile? Of what use is it?

8. Of what use are the kidneys?

9. What happens when the liver and the kidneys are injured by disease?

10. What is "auto-intoxication"?

11. What two kinds of germs are found in the intestines? What does each produce?

12. Which germ feeds on carbohydrates? Which upon proteins?

13. What did Professor Metchnikoff find in his experiments as to the causes of old age?

14. What foods putrefy most easily?

15. How may the diet be regulated so as to reduce the number of poison-forming microbes in the body?

16. What effect has the retaining of wastes upon one's health? Why? What may result from neglecting the warning to expel the wastes of the body?

17. How soon after food is eaten should the wastes pass out of the body?

18. What foods stimulate intestinal activity?

19. What effect has exercise upon intestinal activity?

20. Is fasting a good remedy for auto-intoxication? Why?

21. What is intestinal action? How is it caused, and what is its importance?

CHAPTER XII

How the Body renews Itself

About one third of our life — eight hours out of the twenty-four — is spent in sleep. Why is this necessary? It would be most unwise to spend one third of our time in bed unless we accomplish something by it. This period of inactivity gives the little cell builders of the body the opportunity to carry on the work of repair and prepare the body for more work in the future.

Windows all closed: pupils dull and drowsy.

Keeping "in good repair."

Some people keep their houses always "in good repair." A broken pane of glass is at once replaced by a new one. A leakage in the roof is mended before there is a chance for the house to be damaged by water's leaking through. The woodwork of the house is preserved by being given a

fresh coat of paint whenever necessary. But some shiftless people let their houses "run down" until there is such an accumulation of repairing work to be done on it that they either have to move out altogether or else be put to great inconvenience while the house is turned over to the workmen for the necessary repairs. When a person does not take enough sleep every twenty-four hours to keep the body "in good repair," the amount of work to be done on it accumulates, until finally he has to take a long period of rest on account of nerve exhaustion or some other malady caused by his being "out of repair."

WINDOWS OPEN: PUPILS ALERT AND INTERESTED.

An interesting experiment.

A scientist who wanted to find out the effects of work upon the nerve cells made some experiments with birds for this purpose. Dr. Hodge took the active little English sparrow and made examinations in the morning after a night's rest and again in the evening after a day's activity. He found that in the evening the cells were shrunken

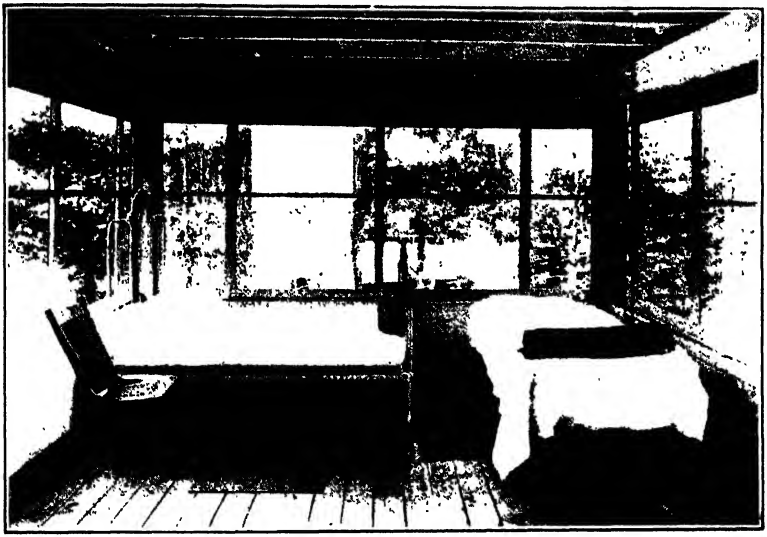
and much smaller than they were in the morning. Experiments with swallows and bees showed the same thing. Before work, the cells were round, smooth, and regular; but after a long period of work they were irregular in appearance, shrunken, and jagged. During the day the birds were using up nervous energy; the nerve cells were broken down faster than they were built up.

Sleep for body building.

All the tissues of the body are built up while we are asleep. Sleep is the time of growth, of renewal and rebuilding. One reason an infant grows so fast is because it sleeps so much. When a person loses sleep he is likely to become pale. After a good rest his color will probably improve and he will look as though he had more blood circulating in his veins. If a drop of blood from a person who has lost several nights' sleep is examined under the microscope and the cells counted, it will be found to have fewer blood cells and less hemoglobin than normally. But if examined again after several nights of good sound sleep, it will be found that both blood cells and hemoglobin have increased. The blood is made principally while we are sleeping.

Another important thing that takes place in sleep is the storing up of oxygen in the tissues. When we are active we use up the oxygen that we store up while asleep. For this reason, it is important that one should get as much fresh air as possible during sleep. This can, of course, best be done by sleeping outdoors. Most modern houses now contain out-

door sleeping apartments. People obliged to do sedentary work indoors during the day can at least spend one third of their time — the sleeping hours — in the fresh air.



MOST PEOPLE ARE REFRESHED MUCH MORE BY SLEEPING OUT-DOORS THAN INDOORS.

Changes in the circulation during sleep.

Dr. Mosso's balancing board showed, you will remember, a change in the balance when the person reclining on it fell asleep. The feet went down and the head up. What caused this change? If the person were suddenly awakened, the balance would be reversed. The feet would come up and the head would go down, showing that the amount of blood in the brain had increased.

The nerve center that has control of the blood vessels, or the *vasomotor center*, as it is called, is situated in the medulla oblongata (See *The Body in Health*, p. 211) at the base of the brain. We might compare the vasomotor center to a factory superintendent's office from which directions are telephoned to the foremen of the different departments. The vasomotor center in this way holds a grip, as it were, upon all the blood vessels of the body. When the vasomotor center becomes tired, it loses its grip to some extent, so that the blood vessels of the body relax or dilate and so contain more blood, and this means, of course, less blood in the brain. The blood recedes from the brain to the extremities. In a patient in whom Dr. Mosso was able to see the brain through a hole in the skull, he noticed that its volume decreased in sleep, while careful measurements with an instrument called a *plethysmograph* showed that the volume of the extremities — the hands and arms, the feet and legs — increased, showing that they contained more blood. This change seems to be for the purpose of keeping the limbs warm during the inactive period of sleep.

A person who is tired has less blood in the brain than one who is fresh, and this decrease of blood in the brain is thought to be one of the principal causes of sleep. We all know that anything which tends to send the blood to the brain, — mental activity or excitement, — causes wakefulness; while, on the other hand, anything that tends to draw the blood

away from the brain. — a heavy meal, for instance, — makes us drowsy. A hot foot bath or "leg pack" is useful in producing sleep, because by drawing the blood to the extremities it will lessen the amount in the brain.

Even a sleepy person will become wide awake at once if something occurs which specially interests him, because the brain begins to exert itself and so calls for more blood. You can see an instance of this in almost any public gathering. When the exercises are dull, you are pretty sure to see some of the people falling asleep. But if the lecturer begins to tell an interesting story or to throw pictures upon a screen, everybody wakes up, because his interest in the proceedings draws more blood to the brain.

Dullness due to tiredness.

Experiments have shown that at night when we are tired our nerves do not respond as readily as in the morning when we are fresh. This is thought to be due largely to the presence in the blood of the fatigue poisons resulting from work. The lessened activity of the nervous system when we are tired causes us to be less sensitive to our surroundings. We lose our keen interest in what is taking place about us, the brain calls for little blood, and we may drop off into sleep.

The influence of sense-excitement in keeping us awake was shown in a case reported by a German scientist of a boy under his care. This boy, who was fourteen years of age, had a peculiar disease of the

nervous system which cut him off from all communication with the outside world, except by means of one eye and one ear. He had lost the sense of touch, and of pain, heat, and cold; he could neither taste nor smell. When Professor Strumpel would tell the boy to close his eye and would then plug the ear with cotton, thus closing up all the avenues to the world without, the boy would immediately fall asleep. Have you noticed that a child who is apparently not at all sleepy will, if made to lie down in a quiet darkened room, soon fall asleep?

Things that prevent sleep.

One sleeps more soundly in darkness than in light, because some light creeps in even through the closed eyelids and stimulates the brain to some degree. You can tell at once with your eyes closed whether or not there is a light in the room. Some people are in the habit of keeping artificial light in their bedrooms. Do you think "night lights" are a good thing?

Any kind of stimulus acting upon us during the sleeping hours makes our sleep less sound and refreshing. You know how difficult it is to sleep indoors on a hot midsummer night. Our nerves are then constantly irritated by the heat. Or in the cold weather, when the bed clothing is not sufficient, one may be aware of being cold, even when partly asleep.

But perhaps the thing that has the most disturbing effect upon sleep is noise. You know how anxious a mother with a sleeping baby is to avoid the least noise

in the house. When one is falling asleep the power to recognize sounds lasts longest. As one awakens,

A NOISY STREET.

he is able to recognize sounds before he is able to make a voluntary movement. The period of soundest sleep has been determined by noting the distance through

which a brass ball must fall to the floor in order to awaken a sleeper. The greater the distance the ball falls, of course, the greater the noise it makes when it strikes the floor. It has been found that it requires a louder noise to awaken a sleeper during the first hour of sleep than at any other period. This fact shows that sleep is soundest during the first hours.

One of Dr. Mosso's patients with whom he made some interesting experiments was a man whose head had been injured by a brick dropped upon it by another man when they were at work upon a church building. As a result of this he had a small hole in the middle of his forehead, through which the brain could be seen steadily throbbing. By means of a delicate instrument that could be inserted through the hole, the brain was made to keep the record of its own pulsations, as the pulse may be made to do by means of the sphygmograph of which you have learned. A pencil connected with the instrument made lines upon a piece of paper, in this way showing the blood supply to the brain and so telling the story of its activity. One of the interesting things that Dr. Mosso discovered by this means was that even during sleep the brain responds to outside disturbances. Any noise in the room, though not loud enough to awaken the sleeper, made a change in the record that was being made by the brain. It caused a certain amount of activity of the brain, which drew an increased amount of blood to that organ and so made the sleep less sound.

One is not awakened so readily by a noise to which he is accustomed as by a strange noise. We may get used to noise so that we are able to sleep through it; but even then the sound impressions pouring into the brain have some effect upon us, making our sleep less sound and restful. A

Bedlam in our cities.

A NOISY FACTORY DISTRICT.

person living in the midst of noise such as is common to-day in our large cities gets no really complete rest day or night. Asleep or awake, the nerve centers are constantly receiving a torrent of irritating noises.

Noisy factories are permitted to locate in the center of residential districts. Locomotives and factories are allowed to blow powerful whistles and steam sirens which in some cases make the windows rattle a mile

away. In these days, when every one can afford a dollar watch, these air-piercing sounds to summon people to their work are not necessary. Then there is the trolley car, with its "screamer," the cry of the newsboy and the huckster, and the screeching of the horns of automobiles flying over the country in all directions. This great increase of noise comes just when people are beginning to live out of doors as much as possible, and windows are kept wide open day and night.

It has been shown that the nervous system has a kind of invisible armor against harmful influences, which the physiologist calls the *quality of resistance.* But this resistance of the nerve cells requires the expenditure of energy, so that the nervous system is constantly taxed to maintain protection against the great volume of noises. A person who is kept in a noisy place continually finds it difficult to adjust himself to stillness. A boy who had spent his life in the ceaseless uproar of a great city, upon his first visit to the country cried out, "Oh, it is too much! the stillness hurts!"

Preventing noise.

"What we need now," says Dr. Lyman Abbott, "is a National Crusade for Quiet. It is not a matter of sentiment, nor even a matter of comfort; it is a matter of sanity, of thoughtfulness for the sick, and of decent consideration for the nerves of a nation."

In respect to the suppression of noise, the city of Berlin sets an example to the world. Berlin is one of

the most active cities of the world, yet its inhabitants never hear a steam whistle, the rattle of wagons, the shriek of a locomotive, or a huckster's cry. Even musical sounds, such as piano-playing, are not permitted after a certain hour at night nor before a certain hour in the morning.

A number of large cities in this country have already abolished the blowing of steam whistles and the ringing of bells in the freight yards. Many of the largest factories use no whistle or steam signals, but their army of employees come to their work by the clock, and the starting up of the engine is the signal for the beginning of work. Muffling or sound-deadening devices are available for application to engines. When it is absolutely necessary to make a loud noise there is no reason why, as has been suggested, the sound should not be musical instead of nerve-racking. Preference is being given in some places to those forms of street-paving which combine durability with sound-muffling qualities. In some cities there is a movement to establish "zones of quiet" around all the school buildings and hospitals. Should you approve such movements as these?

The condition of the body as well as the conditions in the environment have their effect upon one's sleep. People who are happy and contented usually sleep well. But sleep is most likely to be disturbed in persons who are suffering from worry, anxiety, fright, a bad conscience. People

The effect of drugs on sleep.

suffering from insomnia, or sleeplessness, sometimes resort to drugs to make them sleep. One of the most noted nerve specialists of this country says that "Any drug that will put a man to sleep will do him harm in some way." It may in extreme cases sometimes be necessary to use drugs for a short time in order to avoid the greater injury that would be caused by loss of sleep. But it is an important point to remember that the continued use of drugs to induce sleep *always results in chronic insomnia*. A person who gets into the habit of using morphine, for instance, will become unable to rest without it, and he must keep on increasing the dose in order to get any effect from it. His system becomes filled with the poison until he is good for nothing and is likely to end up in the insane asylum.


WHOLESOME EXERCISE OUT OF DOORS IS BETTER THAN DRUGS TO CURE SLEEPLESSNESS.

A regular hour for retiring is conducive to sleep and therefore to health. The keeping of irregular hours is a bad habit that sometimes causes insomnia. Young people who are ambitious and who want to get through

a college course, or make money, or gain time for any work, sometimes try to do so by shortening their hours of rest. But nature is not to be cheated in this way. "Whoever takes up life beforehand," says Dr. Johnson, "by depriving himself of rest and refreshment, must not only pay back the hours, but pay them back with usury."

A simple and harmless remedy for sleeplessness, and one which should be known to every one, is the neutral bath. This is simply a bath in an ordinary bathtub taken just before going to bed. The important thing is to have the temperature just right. The temperature should be 92° to 96°. Never more nor less. The duration of the bath is usually about half an hour, at the end of which time drowsiness will be experienced, or the bather may even fall asleep in the bath. In very obstinate cases, the duration of the bath may be extended to an hour or two. This simple remedy almost never fails when faithfully applied.

Health Problems

1. How many hours do you sleep every night? Do your parents sleep as many hours as you do?
2. How many hours a day does a baby usually sleep? Is this necessary? Why?
3. Describe some person you have seen who has been losing a good deal of sleep.
4. Have you slept in a room with the windows closed? How did you feel when you waked up?
5. What makes people sometimes talk or walk in their sleep?

6. Perhaps you have noticed that your shoes sometimes seem tighter in the morning than they are later in the day. What causes this?

7. Why do people become pale when they are very tired?

8. Write a little essay on *Sound Sleep*, telling all the conditions necessary for complete rest.

9. Why is it that a nurse often sleeps soundly through a great deal of noise, but wakes instantly when her patient moans or rings the bell?

10. Listen to the noises you hear when you wake up in the morning. What are the loudest and most unpleasant? Could they be avoided?

11. If a Crusade for Quiet should be started in your community, what noises do you think could be done away with? Are your streets paved with material that has sound-muffling qualities?

12. What means should you suggest for inducing a wakeful person to sleep?

Review Questions

1. What work is accomplished in our bodies while we sleep?

2. When a person loses sleep, how is his blood affected?

3. Why is it important that a person should get as much fresh air as possible during sleep?

4. What functions are suspended during sleep?

5. What nerve center has control of the blood vessels?

6. Describe the changes that take place in the circulation during sleep.

7. Why does excitement make us wakeful?

8. What effect does a hot foot bath have on a wakeful person? Why?

9. Tell about the boy whom the German scientist studied.

10. In what two ways may sleep be induced?

11. What things are necessary for healthy sleep?

12. When is sleep the soundest?

13. What has been discovered about the response of the brain to noise during sleep?

14. Do people living in noisy cities ever have complete rest? Why?

15. How does stillness affect people who have been used to constant noise?

16. Explain what is meant by a Crusade for Quiet.

17. What effect has a person's mental condition on his sleep?

18. What harm is caused by the use of drugs to induce sleep?

19. What effect on sleep has the eating of a heavy meal just before going to bed?

20. Why is it well to go to bed at the same hour every night?

CHAPTER XIII

GERM PLAGUES

IN an ordinary compressed yeast cake there are billions of living cells, or plants, that are called yeast plants. These cells are so small that we can not see the individuals without a microscope, but we can see the work which masses of them do together. Every one is familiar with the raising of bread when yeast is put into it. Any one can show the working of yeast by putting a few teaspoonfuls of sugar into a tumbler of warm water — just warm enough to hold the finger in — and then crumbling into this a portion of a compressed yeast cake. In a little while the yeast cells or plants will begin to work, and soon gas will be seen escaping with the appearance of a frothy scum on the surface. These changes are due to the activity of the yeast cells, which break up the sugar, forming alcohol and carbonic gas. It is this gas which we see rising in bubbles.

Minute forms of life.

Minute, invisible forms of life exist everywhere about us. They are so small that they can not be seen by the naked eye, but if they fall upon a suitable food, such as the cut surface of a boiled potato or a slice of

moist bread or cheese, they will increase in number so rapidly that in a few days they will form spots or "colonies" which are easily visible. The air always contains a greater or smaller number of these invisible forms of life, but, fortunately, they are usually not harmful.

Our forefathers from remote times until a few decades ago lived without knowing the important fact that there are vast numbers of plants and animals so minute that one can see them only with the aid of a powerful magnifying glass. But when the microscope was perfected, people began to understand that there is a world of living things of which many have never even dreamed. Some one has spoken of this newly discovered world as that of the "infinitely little." As we have come to know more about these microscopic plants and animals, we have come to realize how important they are. They do much of our work, such as preparing our food, carrying off and destroying our waste material, and performing other necessary and useful tasks. Some of them are our friends. They ripen our cream for butter-making, preserve fresh food for cattle in silos, purify sewage by eating up the filth, make the soil fertile, and do us many services of this nature. Many of them, however, are our enemies; and the fact that they produce diseases of different sorts is one reason why we have become so much interested in them, and why we are trying to discover under what conditions they grow and how we can control them.

Secure some moldy fruit or vegetable, or a piece of moldy cheese, and allow it to dry so that it can be pulverized. Then take some fresh bread and cut several slices. This latter work ought to be done in a separate place from that in which the moldy food is handled; it ought to be done by a different person from the one who prepares the molds. Why? Place each of three slices of the fresh bread on a sheet of blotting paper and, on two pieces of the bread, sprinkle a small quantity of the mold dust. Cover one of these with a glass bowl or some other glass dish. The third "unseeded" piece should also be covered with a glass.

The work of microbes.

BREAD MOLD, GREATLY MAGNIFIED.

Those pieces which are covered should be kept moist by placing water on the blotter from time to time. Keep track of developments for a few days. At the end of this period describe what change has taken place on the uncovered piece of bread. What was the object in covering the bread? Note that the molds do not grow unless they have been seeded. If a few molds do grow on the third piece of bread, it simply means that the mold seeds or spores fell on it from the air before it was covered.

In somewhat the same way that microbes produce

decay and rottenness in bread, fruits, and vegetables, special sorts of microbes produce diseases in man and animals. You have already learned of *contagious* or *catching* diseases. We know that a person who has smallpox, measles, or whooping cough is being attacked by microbes, and just as microbes may pass from one apple to another in a barrel, so smallpox, measles, and scarlet fever may pass from one person to another, or from the sick to the well.

Microbes produce disease.

Microbes produce disease in man and animals in different ways. One class grows in our food materials and produces poisons. When these poisons are taken into the stomach with food, they may produce sickness or even death. Some of these poisons are known as *ptomaines*. Instances of *ptomaine* poisoning are frequently noticed in the newspapers. The dangers of ptomaine poisoning can be avoided by protecting food materials, especially meats, from the growth in them of the *putrefaction* or decay microbes or *bacteria*.

Many species of microbes produce disease in man and animals by growing in the body of their victim. They live upon the tissues and fluids of the body. From this flesh and blood they make poisons which cause sickness and death. These microbes are parasites. (What is a parasite?) Diseases caused in this way are spoken of as germ diseases.

A particular germ is often the cause of a particular disease. These germs are usually named after the

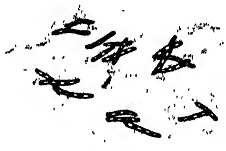
diseases they produce, as the diphtheria germ, the typhoid germ, or the tuberculosis germ. People never have these diseases unless the particular germ which causes them is growing in and poisoning the body. The disease germs always come from parent germs, or from the body itself, and never start from nothing, as some people used to think. These germs always come from some previous case of the disease which they produce. Certain of these diseases are caught by coming in contact with some one having the disease. For this reason they are called contagious (touched; carried). Decay and rottenness in fruit or vegetables is produced in the same way, you will remember. Some other germ diseases are carried indirectly from the sick to the healthy; as, for example, through food or drink, as milk or water; and by means of insects, as flies or mosquitoes. These are called infectious diseases. There is no sharp distinction between infectious and contagious diseases. All contagious diseases are infectious, but all infectious diseases are not necessarily contagious. Why? It should be mentioned that the distinction between contagious and infectious diseases is now considered less important than formerly.

Among the diseases produced by microbes none is more important or dreadful than tuberculosis. The presence of tuberculosis in a family or community is dangerous in somewhat the same way that a rotten apple in a basket is dangerous to all the good apples. But there is this difference: it is practically impossible

to make a rotten apple safe to put with the sound ones. But in the case of tuberculosis and other diseases due to microbes or germs, when intelligent care is used, people suffering from them may with a certain degree of safety mingle with well people. But it must always be remembered that a person suffering from a germ disease is dangerous to the people around him unless everybody is careful to prevent the escape of the dangerous germs from the diseased person, and the entrance of these germs into the body of some one else.

The germ of tuberculosis.

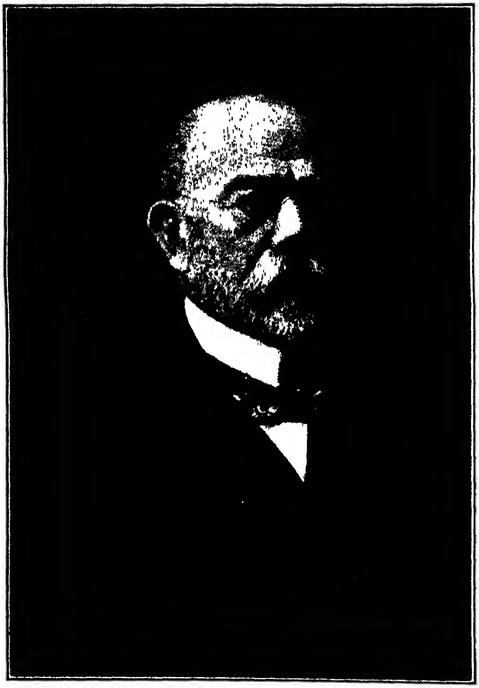
Until late years nothing was known in regard to the cause of tuberculosis. It is scarcely a third of a century since tuberculosis was definitely proven to be an infectious disease. Our ancestors thought it was due entirely to heredity. The credit of discovering the germ cause of tuberculosis belongs to Dr. Robert Koch, of Germany. The discovery was announced in 1882. At the time Dr. Koch made his discovery, scientists were just becoming acquainted with the various disease germs of bacteria. Bacteria, as you have learned, are forms of plant life in which the individuals are so extremely small that they are invisible. In measuring them we use, as the unit of measurement, what is known as the micron, which is about $\frac{1}{25000}$ of an inch. Many of the bacteria are only about one micron in length and they are rarely more than a micron in width. This means that



GERM OF TUBERCULOSIS.

250 of such bacteria placed end to end would just about equal the thickness of a piece of the paper on which this book is printed.

Different bacteria vary greatly in shape. Some are minute glistening balls, others short rods, others long slender rods, and still others have a spiral shape. The bacillus or germ of tuberculosis is a straight, narrow rod, about half a micron wide, and five or six microns long. Many kinds of bacteria can be grown artificially by feeding with preparations containing meat extract. A broth made very much like a beef consommé is frequently used. To this is often added gelatine or agar-agar (a vegetable gelatine), and in these few substances, or media, as the scientists say, most bacteria grow readily. The bacillus of tuberculosis, however, is a



Dr. Robert Koch.

very dainty microbe, and it will not grow in the media named above unless a little glycerine is added, in which case it grows well, but slowly. It grows very well upon the fluid or watery part of the blood, either human or animal, which has been hardened by heat. Except when introduced into such media as just mentioned above, the tubercle bacillus does not grow outside of the animal body. This is very fortunate for us, because, if it did increase in numbers outside of the body, the whole world of men and animals would have been exterminated long before this.

Although the germ of tuberculosis does not grow and reproduce outside of the body, except on special "culture media," still it does sometimes *live* outside the body for very long periods, simply retaining its vitality, ready to grow when the conditions are right. This germ can withstand drying for months and even years. It may live in putrefying (rotting) or decaying material for a long time and in dark, dirty corners of buildings for years. One of the best ways of killing it is to allow the *sunlight* to reach it. It will be killed also more quickly in a *dry* than in a *moist* place. Hence, the necessity of dry, well-ventilated, and light rooms.

The nature of tuberculosis.

Nearly every one has seen people who were thin, with hollow cheeks and narrow chests and who had a dry, hacking cough. Such people are sometimes said to be suffering from bronchitis; but in most cases, it sooner or later appears that they have consumption, or tuberculosis of the lungs.

Hunchbacks have deformed spinal columns which have been injured and twisted on account of disease of the spine bones. This is one of the results of tuberculosis. Hip disease is common. On account of disease, the hip has been deformed, and the hip joint destroyed or stiffened so that it can not be used. If we knew the history of these cases, we should find that almost always this injury to the hip joint had been brought about by tuberculosis. Diseases of the bones in other parts of the body are frequently caused by tuberculosis. Often, especially in children, diseases of the intestines, which are serious and difficult to treat, are caused by tuberculosis.

We have already noticed that tuberculosis is a disease caused by the growth in the body of a germ or microbe known as the *Bacillus tuberculosis*. When the germ gets into the body, it grows in the tissue, destroying the cells all around it. It also makes certain other cells grow, causing the production of *nodules* or *tubercles*. These are shown in the accompanying illustration. This formation of tubercles is peculiar to this disease and has given it the name *tuberculosis*. This germ may grow in any part of the body, but in human beings it grows most frequently in the lungs. When tuberculosis occurs in the lungs, and especially after the disease has gone on for some time, it is known as *consumption*. In the United States, about nine people die of consumption to one that dies from some other form of tuberculosis; so that consumption is by far the most important form of this disease.

What is the most frequent cause of sickness and death? If you were to go to the health officer in your city or town and ask him what was the chief cause of death in your community, he would almost certainly reply "Tuberculosis." If your health officer had a record of the living cases of tuberculosis, as he really ought to have, he would tell you that there are far more cases of tuberculosis than of any other disease; and at any one time there would probably be more cases of tuberculosis than there were cases of all other infectious or germ diseases together. So that it is fair to say that tuberculosis is the greatest plague with which the human race is afflicted, because of all diseases common to mankind, it is the most widespread. John Bunyan very appropriately called tuberculosis the "Captain of the Men of Death." Tuberculosis causes more deaths each year than scarlet fever, measles, typhoid fever, diphtheria, whooping cough, and influenza combined. Study the chart and see how this fact is shown. We think of the terrible loss of life due to war, but tuberculosis kills many more people than war ever has done; and it always keeps on with its work. It never grants a truce. The entire loss of life in the Franco-Prussian war was only about one half the loss from tuberculosis in Prussia alone for a single year. The loss of life in our country, due to tuberculosis, in any four years is more than half a million persons, or about three times the loss of men during the four years of the Civil War.

The extent of tuberculosis.

In the nineteenth century there were many terrible wars, and it is estimated that fourteen million soldiers died on the battle field. But while these wars were going on, thirty million people in the very same countries died of tuberculosis. The number of deaths in the San Francisco earthquake was only a little over one half of the loss of life every year in San Francisco from tuberculosis. The great earthquake in southern Italy destroyed many less people than die each year of this disease in the United States. In the United States, from one hundred and fifty thousand to two hundred thousand die every year, and, in the world, a million and a half. The terrible price we have to pay for the neglect of this disease is impressed upon us if we realize the fact that of the ninety million people now living in the United States over nine million of them will die from tuberculosis, unless conditions are improved; and of these nine million, two hundred and fifty thousand will be in the state of Wisconsin.

The waste in dollars and cents caused by the disease has been estimated by a number of people, and according to Professor Fisher we lose in the United States each year one billion one hundred million dollars ($1,100,000,000) as a result of the disease in human beings; and fourteen million ($14,000,000) more as a result of the disease in cattle. This loss far exceeds the value of any crop in the United States. In fact, if we should lose one entire corn crop, and also the cotton crop, but could save one year's loss from tuber-

culosis, we should, as a nation, be better off than we now are. The loss of the dairy products, the wheat, the forest products, the rice, and the small-fruit crops of a year would scarcely exceed in value the present loss from tuberculosis. Besides these enormous money losses, the human race has suffered untold miseries from tuberculosis. It has caused poverty and suffering beyond anything that can be measured. Tuberculosis has helped to fill our insane hospitals and orphan asylums, our homes and hospitals for crippled children, our reformatories, and even our prisons and penitentiaries. It has deprived us at an early age of many of the most brilliant men and women in all periods of the world's progress.

Justice Charles E. Hughes, United States Supreme Court, has said:

"If we had through the misfortunes of war, or the sudden rise of pestilence, or through some awful calamity, the destruction of life that annually takes place on account of the spread of the white plague, we should be appalled. Mass meetings would be held in every community and demand would be made that the most urgent measures should be adopted. It is only because we are accustomed to this waste of life that we can look calmly on and go about our business, paying no attention to this enormous death toll, which our American people are paying."

In a preceding chapter it was shown that the sputum of persons suffering from tuberculosis of the lungs

may, and often does, contain the bacilli or germs of tuberculosis. These germs may be carried from one place to another through the sputum. In the case of persons suffering from consumption, the germs leave the body almost entirely in the sputum. In the case of animals suffering from the disease, the meat and milk may contain the bacilli, and hence be the means of spreading the disease. In the case of both man and animals, *pus*, or the matter coming from the tubercular sores, may serve as a means of scattering the germs. It is generally believed that tuberculosis is very largely passed on from one person to another by means of the sputum. If this material is not destroyed, it dries, becomes pulverized, is then blown about, and may enter a well person with the air that is breathed. It is estimated that the sputum given off in twenty-four hours by a person in the last stages of the disease may contain as many as seven billion tubercle bacilli. Considering the number of careless consumptives, it is no wonder that the air in certain buildings, or localities, frequented by consumptives, is loaded with germs.

The spread of tuberculosis.

When one talks, but especially when one speaks forcibly, coughs or sneezes, there is driven out from the mouth a fine spray made up of tiny drops of finely divided sputum. These droplets contain, in the case of consumptives, the germs of tuberculosis; and if these are breathed in by a person inclined toward the disease, they may take their abode in him and grow vigorously.

However, the danger of this is really great only when one remains very near a tuberculosis patient for a considerable length of time. At a distance of three or four feet there is likely to be but little danger of infection. From a consumptive, these little drops of sputum are constantly falling on the floor and the furniture and

A HEALTHY HERD OF DAIRY CATTLE.

even on food, and it is important that this source of danger should be avoided. In the case of tuberculous ulcers, abscesses, and such diseases, the discharge contains the germ and must be carefully handled to prevent the spread of the disease.

Cows, even when they have tuberculosis, do not usually cough; hence there is little danger from their

sputum. But the milk contains the tubercle germs, not only when the udder is affected, as claimed a few years ago, but also when the infection exists in other parts of the body. The United States Department of Agriculture has recently found that milk may become infected with tubercle germs through particles of manure falling into it.

In cattle the disease is most often located in the internal organs and not in the muscles; hence the danger of infection by eating meat from infected animals is not so great as it otherwise might be. Nevertheless, it has been shown that the germs are often present in the meat of cattle which have had tuberculosis, and were it not for the fact that meat is usually cooked before it is eaten, thus killing the germs, it would be an exceedingly active source of tuberculous infection. As it is, it is estimated that fully ten per cent of all cases of tuberculosis are contracted from tuberculous meat or milk.

Killing the germs of tuberculosis.

As we have seen, tuberculosis is not inherited; but, in almost all cases, it is taken by a susceptible person coming into contact with some one having the disease. We need to repeat for emphasis that, if we are to prevent the spread of the disease, we need to see that those who have it *take proper care of themselves*, so that the germs which they are giving off do not make their way to some one else. When one is suffering from consumption, as you have already learned, the germs are given off in the sputum in enor-

mous numbers, and the important thing to do is to prevent this sputum from drying. A consumptive should never spit on the floor (in fact, no one ever should) or any place where the sputum will become dry. A handkerchief is perhaps the worst thing that a person could use. It is best to have either a spittoon, containing some chemical substance that will destroy the bacteria, or, what is better, to have little paper cups or napkins, which when they have been used, can be burned. *If we could kill all the germs in the sputum of those suffering from tuberculosis, the disease would rapidly diminish and perhaps in time disappear from the world.*

It is possible for the germs of tuberculosis to be transmitted from cows to human beings, particularly children, through milk. In order not to get disease by drinking milk, it is necessary that all the milk sold on the market or used in the home should be from cattle known to be free from tuberculosis. Fortunately, it is possible readily to test cattle for tuberculosis by means of what is known as the "tuberculin test." This test does not cost much, is easily used, and is very accurate. Farmers are finding that it pays to have all their cattle tested, because tuberculosis in cattle is as "catching" among cattle as it is among men, and perhaps more so. If the disease once gets into a herd, it will be sure to spread unless it is promptly checked.

Flies help to spread this disease. No one knows the proportion of cases that they cause, but it is very important that flies should be kept away from food.

This ought to be done by trying first of all to limit the number of flies produced. This can be done by caring for manure, garbage, and things of this nature, in such a way that the flies can not breed in these materials. Secondly, we should screen our houses and keep flies

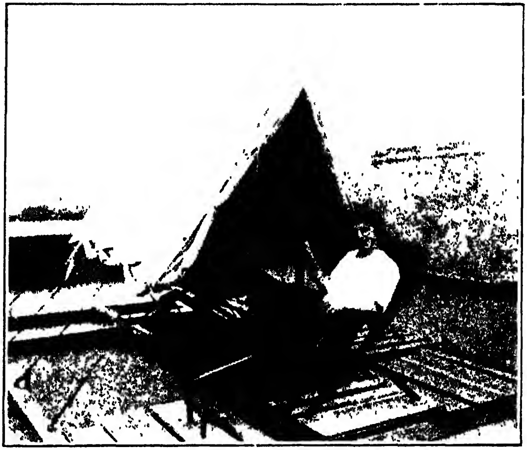
Courtesy of Committee for Prevention of Tuberculosis.

OPEN-AIR CITY CAMP FOR CONSUMPTIVES.

out of the kitchen and the dining room, particularly. In addition to this, we should take especial care to protect all food from flies by screening shelves or other places where food is stored. Flies carry on their feet the tuberculous germs from sputum on the street, or in the gutter, or elsewhere. As they walk over the

food they leave these germs, sometimes in very large numbers, and the disease is thus spread. They also carry typhoid fever germs and spread them. The common house fly is now sometimes called the "typhoid fly."

One very rarely gets tuberculosis out of doors, but almost always in the house, or in the workshop. Hence, it is of the very greatest importance to have houses and workshops most carefully disinfected when people having consumption are present, and especially when they leave. Where people having consumption occupy buildings and are careless, these buildings become real tuberculosis nests, or breeding places. It is a matter of extreme importance, therefore, when one moves into a house which other people have lived in, to find out whether the disease existed there, and if it did to have the house properly disinfected before going into it.



Courtesy of Committee for Prevention of Tuberculosis.

CURING CONSUMPTION IN THE CITY. PATIENT LIVING ON THE ROOF.

This is a matter which must never be overlooked, and no one having a family in his or her care should move into an infected house until it has been properly prepared, by being most thoroughly cleaned and disinfected.

Other means of preventing tuberculosis.

A very important part of the work of prevention of tuberculosis is the development and maintenance of the normal or natural vigor of the body, or the conservation of health tone. The person who is in ill health, or in a state of low vitality for whatever cause is much more liable to be attacked by tuberculosis, as well as by other diseases, than is a person in good health and vigor. Among the things which may be considered as helping to cause tuberculosis are certain kinds of work, overcrowding in homes, schools, and workshops, because of poor ventilation, unhealthful conditions, dust, and bad housing, for these lower the health tone.

The comparative frequency of tuberculosis among people of different occupations has been studied. Persons who work indoors head the list, while farmers and other outdoor workers are lowest in the list. Where one is free to choose his own work, it is worth while, before he makes a selection, to consider the relative healthfulness of various occupations. It seems probable that many kinds of work can be made less dangerous than they are now. The chief reason why it has not been done in the past is because the importance of *preventing* disease has not been realized. The young people who are growing up should and will undoubtedly do much in

this direction. It is not merely a question of indoor and outdoor occupation, for some of the outdoor occupations have a marked influence in producing consumption. Statistics show that the percentage of tuberculosis among quarrymen is higher than it is among many indoor workers. Why?

Overcrowding in houses helps to make people more likely to have diseases, especially tuberculosis. If we should count up the number of people who live in one-room apartments, compared with the number who live in apartments of two, three, four, or more rooms, we should find that there are not so very many; but if we should compare the amount of sickness and death among those in the single-room apartments with the amount among those who have more room, we should find that the percentage of sickness and death would be very much greater; and any one who is obliged to live in crowded quarters, in either the home or the work-

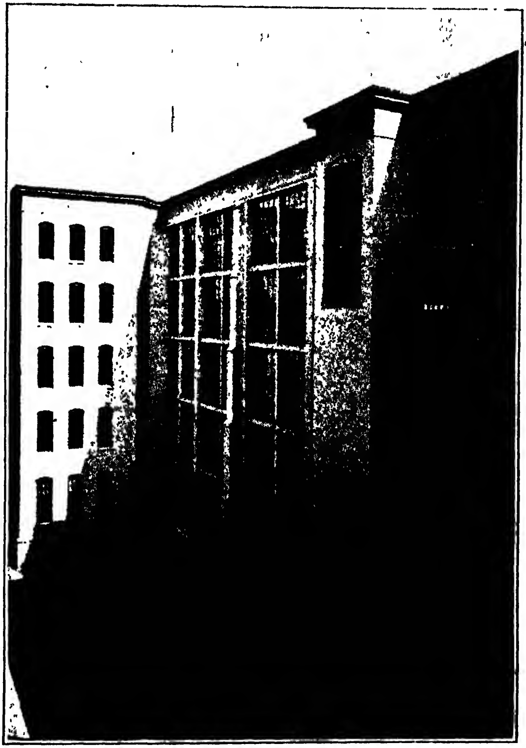
Tuberculosis germs like back yards as filthy as this one.

shop, is taking a much greater risk of contracting disease than the people who have more space. Sometimes people who could have plenty of room, if they wished, coop themselves up in cramped quarters for the sake of convenience, or to keep warm. If they would use a larger space, exercise more, and if necessary, spend a little more money on fuel, they would be better off.

The lack of fresh, pure air in the house or the work-room or the schoolroom keeps people in a state of vital depression so that they are inferior workers and are likely to take diseases. Far too many buildings are without good light and proper means of ventilation. In olden times, methods of constructing houses were much inferior to the present, and on this account buildings were far less tight than they are to-day. And then, too, the method of heating was at one time entirely by means of open fireplaces. Under these conditions, special means of ventilation were not needed as they are at the present time, with air-tight buildings and our steam and hot-water plants.

All buildings where a number of people are working should be provided with a *special means for bringing in pure air.* The constant change of air in an ordinary living room, called ventilation, may take place by natural means, but in larger rooms and buildings, where there are a good many people, mechanical means should be employed to change the air forcibly. This can be done by the use of fans which drive pure air into, or which draw the impure air out of, the room. In some build-

ings both systems, forcing in and drawing out, are used. Public buildings, such as factories, workshops, stores, and schoolhouses, as well as private homes, should in these days be built around a good ventilating system, as they were formerly built around a chimney. In case buildings must be used without special means of ventilation, a great deal may be done by bringing pure air in constantly through the window and other openings.



Courtesy of National Cash Register Co.

NOTICE THE VENTILATION IN THIS FACTORY BUILDING.

In order to secure a constant supply of fresh air, it is necessary to train the sense of smell so that it will detect impure air. We are likely to grow careless in regard to this; but any one who understands

the importance of pure air may after a while become so sensitive to bad air that he will be uncomfortable in it. Some people think of such a person as a "crank," but in reality he is very wise, and we ought to follow his example and demand pure air for our lungs, as we now demand pure food for our stomachs, and clean clothes for our bodies.

ONE SHOULD NEVER SWEEP WITHOUT BEING SURE THAT THE DUST WILL NOT RISE INTO THE AIR.

Our houses are too frequently in an unhealthful condition, due to lack of proper cleaning. This sometimes occurs because people who have charge of a home have not been brought up to appreciate that cleanliness is next to godliness, and immensely important. But it is probable that such persons are comparatively few. Most people would like to keep their houses clean, but on account of conditions beyond their control, many have scarcely the time or strength for it. We can overcome these difficulties only by helping to change the social conditions for such people; and we can do a great deal more than might at first be thought possible.

Our ways of cleaning are not all so good as they might be. For instance, in sweeping with a dry broom, we stir up a good deal of dirt from its hiding places; much of this dirt merely gets into the air in the right form to breathe. It is perhaps true to say that dry sweeping, instead of making a place more healthful,

THE BEST METHOD OF CLEANING IS WITH A VACUUM CLEANER.

really makes it more dangerous. The same thing is true in regard to methods of dry dusting. The feather duster, or the dry dust-cloth which is shaken in the room, is a very good way of getting dust into the air and of *not* getting rid of it properly.

The best way to clean is with a good vacuum cleaner. By means of this all the dirt is taken out of the house

without stirring up dust. There are, however, some inferior cleaners which throw the dirt back into the room, and these, like the broom, must be considered as enemies of health. Where vacuum cleaners are not possible, a carpet sweeper may be used, or something may be put on the floor, such as wet strips of paper, tea leaves, or some of the prepared dust-layers. For dusting, special cloths may be bought or prepared which hold the dirt, or a *damp* cloth may be used.

Many houses are built over damp and dark cellars. This is very wrong. There is no excuse for a dirty cellar. Sometimes cellars and halls in apartment houses are not properly cleaned, because no *one* person has complete control of them. They are neglected on the principle of "Every one's business is nobody's business."

Damp cellars are very generally known to be unhealthful. Few landlords would be willing to live over damp cellars themselves, and no landlord ought to be permitted to allow his tenants to live in such surroundings. In these days when cement is so cheap and so generally used, there seems no excuse for it.

The cellar must be ventilated and lighted. Many germs grow best in dark damp places. The perishable things which are usually placed in a cellar furnish good food for germs and encourage their growth if not properly cared for. From many a dark damp hole under the house ascends a pestilential flood of germs continually through cracks in the floor, and whenever the

cellar door is opened. The air of the cellar should be kept as clean and sweet as that of any other part of the house. Air and light hinder the growth of contamination molds and germs. Frequent whitewashing and occasional disinfection are excellent means of keeping a vegetable cellar free from air-polluting germs, besides cutting off the vermin likely to grow and hide in such places.

It is important to have all garbage carefully and regularly removed and buried or treated so as to destroy germs.

Sometimes houses are well kept inside, but have dirty and unsanitary back yards. The back yard ought to be as clean as the front yard, and some means of taking care of the necessary refuse about any building should be provided. The plan of hanging bags so that they can be readly filled with old paper and tin cans is excellent.

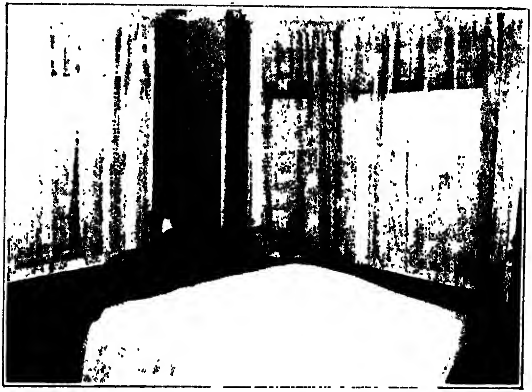
Garbage should also be carefully taken care of. In the city, where it is collected, it is important to have for it cans or boxes properly protected from flies.

Where the garbage must be cared for on the place, this can be done by burying it or burning it.

Another thing that should be especially attended to about the house, or any building occupied by people, and especially the schoolhouse, is the *plumbing*. Defective plumbing allows the escape of gases and odors into the house, and these are known to be active means of lowering the *health tone*.

Dust, either inside or outside of the house or school building, when breathed into the lungs, is harmful. It undoubtedly is the cause of disease, and especially of diseases of the lungs, such as consumption. Some kinds of dust are much more irritating, and so harmful, than others. *Metallic* dust, especially when the particles have sharp, cutting edges, is likely to be very injurious; the dust caused in making knives and forks, and so on, is very bad for the health. Other dusts are not so bad, but they may cause serious changes in the lungs. Hard dust, such as that produced by working on stone, is likely to be harmful. Coal dust acts in the same way. When these little particles of dust are breathed in, they make their way from the air cells to certain parts of the lungs, where they gather in large numbers. They are carried to these tissues by the white blood corpuscles. The effect of the gathering of these particles in the lungs is the most easily seen where coal dust is breathed in; and if it were possible for us to see the lungs of those who handle coal, and those who live in big cities, especially where a great deal of soft

coal is burned, we should notice that parts of the lungs were coal black in color, and in this respect would be very different from the lungs of a person who had always lived in the free, open country. The bad effects of the constant breathing of dust-laden air are easily shown when the death rate from consumption in different occupations is studied.



THERE IS PLENTY OF LIGHT AND FRESH AIR IN THIS ROOM.

The lighting of a house is a matter of no small importance. Houses ought to be so arranged that the sunlight will enter through at least one window, in every room, during the course of the day. Those rooms that are the most used should be the best lighted. It is important, then, to build houses with reference to the lighting. It is not at all necessary that a house should face the street, or even that it should be built facing a beautiful outlook. Houses ought always to be built with reference to the sunlight. The size and arrangement of the windows should depend upon what is the most healthful and not upon what looks best, although

it is perfectly true that houses can be made suitable to live in, and at the same time beautiful to look upon. *The amount of window space in a room should be at least one fifth of the floor space.*

The necessity for light in buildings was realized long before the real reason was discovered. There is an Italian proverb that says, "Where the sunlight does not enter, the physician does." One reason, at least, why this is true, is that the sunlight *kills the disease germs.* Sunlight is, as we say, a good germicide or germ-killer. In building a house, the first thing to be thought of should be the effect which the location and arrangement would have upon the health of those who are to live in it. It is not enough, however, to have properly constructed buildings.. They must be sensibly used. Windows are of little use if the shades are always drawn, or the blinds always closed. A large bedroom or living-room may easily be overcrowded. Sometimes people who have all the room they need, live in a little ill-smelling kitchen in the daytime, and a stuffy, foul bedroom at night. These people, of course, do not realize how bad such a life is for themselves and their children. Warmth is of course necessary, but warmth with overcrowding and lack of pure, fresh air and sunshine may lead to disease and early death, while pure air and sunshine, even with some discomfort from cold, build up the resistance of the body, and promote vigor, freedom from disease, and long life. There are many things worse for health than being cold — for instance, being

overcrowded, and having too little pure, fresh air, and bright, life-giving sunshine.

It is sometimes supposed that these ills which we have been talking about are found only in the city, but this is not true. Housing conditions are often as bad in the country as they are in the city. It is true that in the country there is plenty of pure air and bright sunshine, and frequently the houses are large enough, but the people are likely to be overcrowded in certain rooms, as the kitchen and sleeping rooms, for short periods of time in the summer, and long periods in winter. The desire to *save money* has led people to be careless about healthful conditions; and small rooms are frequently built and used because they do not require much fuel for heating. This is a poor way of saving, as people

Courtesy of Committee for Prevention of Consumption.

EVERY ONE SHOULD BE REGULARLY EXAMINED FOR TUBERCULOSIS, AS A PRECAUTION TO HIMSELF AND FOR OTHERS.

would readily understand if they stopped to think of the matter. The cost of a doctor's bill and perhaps a funeral may easily more than offset the "saving" in fuel and sufficient room.

Health Problems

1. Try to make an experiment which will show there are living things so small that we can not see the individuals but we can see the results of their growth.

2. When people can cherries, pears, and other fruits why do they try to make the cans air-tight?

3. Take a good, sound apple, and place it so that it touches a rotten one. Then take another sound one, wrap it in waxed paper, and place it so that it touches the rotten one. Observe what happens to the sound apples after a few days. Explain.

4. What is meant by a *contagious* disease? Does a well person have actually to *touch* a sick person in order to take his disease? Explain.

5. What is meant by a *preventable* disease? Mention ways of preventing such diseases.

6. If you can do so, expose a gelatine or agar plate to the air for a few minutes. Then cover it up, and leave it in a warm place for a few days. Describe and explain what you find on it.

7. What is the meaning of a "culture" of a germ, as of tuberculosis?

8. Does your town or city have an "anti-spitting" law? If so, what are the provisions of the law? Is it right to have such a law? Why?

9. Does your town or city have a milk ordinance? If so, what are its provisions? Why was the law made?

10. Write a theme on this topic: "Ways and Means of Reducing Tuberculosis in this Community."

Review Questions

1. What are cells? Describe them.

2. What useful things do some microbes perform? What harm do some of them do?

3. What causes the raising of bread? What causes mold on bread, vegetables, and similar things?

4. In what two ways do microbes produce disease? Explain what is meant by *ptomaine* poisoning.

5. What is an infectious disease? A contagious disease?

6. Is tuberculosis an infectious or a contagious disease?

7. What causes tuberculosis? Why did our forefathers think it was a hereditary disease?

8. Tell about the tuberculosis bacillus. What is the best way to kill it?

9. Describe a person you have seen who had consumption.

10. What often causes a back to hunch? A hip to become diseased?

11. What disease causes more deaths than any other in the world?

12. Explain how people ill with consumption may give the disease to others.

13. Tell just how a consumptive should take care of himself so as to prevent the spread of the disease.

14. How may cows be the cause of tuberculosis among people? Is the meat of these cows dangerous? The milk?

15. What part do flies have in the spread of tuberculosis? How may this be prevented?

16. How may one develop and preserve the "health tone" of the body, so that he will not be liable to get tuberculosis?

17. What occupations are likely to incline a person toward the disease? Why? What occupations are healthful?

18. Explain how overcrowding may assist in the spread of tuberculosis.

19. What effect has dust in the spread of tuberculosis?

20. Tell how a house should be built, lighted, and cleaned so that the occupants will be able to preserve their "health tone."

21. What is said about the effect of dirty cellars on the health of the occupants of a house?

22. How may defective plumbing be the cause of lowering the "health tone"?

23. Tell what you think are the best ways of preventing the spread of tuberculosis in a community.

CHAPTER XIV

Living Long and Well

In the sixteenth century the average length of human life was between eighteen and twenty years. At the close of the eighteenth century it was a little more than thirty years. To-day it is about forty-five years. The average length of life has, then, more than doubled in the last three hundred and fifty years.

What has caused this great increase in the average length of life? Is it because men now live to a greater age than in the past? On the contrary, there are few examples of longevity in the last two or three hundred years that can at all compare with those of former centuries.

One thing that will help us to find the cause is the fact that the average length of life is different in different countries. In India it is only twenty-five, while in Germany it is forty-three, and in Sweden forty-five. In Germany and Sweden great attention is given to hygiene; the health of the people is safeguarded on all sides by health boards and sanitary regulations. In India, on the contrary, among the masses of the people, there is no attention whatever given to hygiene or

sanitation. We find that the increased average length of life in various parts of the world exactly corresponds to the attention given to hygiene.

What sanitary science has accomplished.

It is, of course, easily understood that the average length of life depends upon the death rate. Where the death rate is high, the average length of life is shorter than where the death rate is low. The low average of former centuries was largely the result of the plagues and pestilences which in the Middle Ages swept over the world unchecked. Millions of people were sometimes carried off in a single year, and whole cities and provinces were depopulated.

In the fourteenth century the "Black Death," now thought to have been the bubonic plague, destroyed about twenty-five million people, — one fourth the population of Europe.

In 1466, forty thousand people died of plague in Paris.

In 1570, two hundred thousand people in Moscow and vicinity were carried off by plague.

In the year of the Great Plague of London, 1665, the population of that city was estimated at 460,000. Two thirds of these, or about 300,000, fled to escape the disease, and the grass grew in the streets of the deserted city. Of the 160,000 who were left, 68,596 died of the plague.

At the present day the terrible epidemic diseases that formerly caused such a high death rate — the plague, cholera, typhus and yellow fever, smallpox — have

been largely overcome by the discoveries of modern science. These diseases are not, however, destroyed; they are only held at bay. Any carelessness in preventing them would open the door for them to return upon us. Our freedom from smallpox, for instance, we owe to the practice of vaccination. The elimination of rats is now recognized as a necessary safeguard against bubonic plague, which may invade any American community that fails to destroy its rats.

Such diseases as scarlet fever, diphtheria, typhoid fever, measles, tuberculosis, have also been greatly reduced by hygienic measures, and this has also reduced the death rate. In London during the seventeenth and eighteenth centuries the death rate was eighty per thousand; it is now only fifteen per thousand. The death rate from tuberculosis has diminished in England two thirds in seventy years. In Munich the annual death rate from typhoid fever was reduced from twenty-nine to one by filling up the cesspools and improving the water supply. The United States Census Bureau reports show that the average annual death rate from typhoid in certain cities has been reduced from 69.4 per 100,000 to 19.8 by the introduction of pure water supplies.

But, although so much has been accomplished, much yet remains to be done in this line. "It is within the power of man," said Professor Pasteur, "to rid himself of every bacterial disease."

In a report to the National Conservation Committee, Professor Fisher stated that of the 1,500,000 deaths that

now occur in this country every year, at least 600,000 — more than one third — are needless. He obtained this information by taking up in order each of the more than ninety causes of death according to the United States Census, and obtaining from experts on each of the diseases an estimate of how many of the deaths were preventable. On this basis it worked out that if the people who now die needlessly could be given the lives that they should have had, the average duration of life in the whole country *would be increased by fifteen years.* Instead of being forty-five, it might be sixty.

What remains to be done.

Among the causes of death now known to be preventable are tuberculosis, diarrhea and enteritis, pneumonia, violence, typhoid fever, and diphtheria. The following table shows the years that would be added to the average life span if these causes of early death were prevented by means which are now well known and practical.

Tuberculosis	2
Diarrhea and enteritis	2.32
Pneumonia	0.94
Violence	0.86
Typhoid fever	0.65
Diphtheria	0.53
	7.30

The addition of the 7.3 years now lost by these causes alone to the 85,000,000 persons now living in the United States would give a total of more than 620,000,-

000 years of human life saved, the equal of more than 15,000,000 lives of the present average length in this country, more than one sixth of the total population. What a marvelous and beneficent accomplishment the saving of this amount of human life would be; something much better worth while than the building of dreadnaughts or the erecting of costly monuments for the dead. The same effort and the same care now devoted to the saving of animal life would not only save this 7.3 years of life to every man, woman, and child in the United States, but would add many more years.

The true measure of race vigor.

It is an honor to a country to have a low death rate. It shows, as we have seen, that much attention is given to sanitation, and that the hygienic condition of the country is good. It does not, however, give us the true measure of the vigor of a race. The true measure of racial vigor is not the increase of life for all, but the number of persons who attain great age. It is also shown in the power of the race to resist organic or chronic diseases.

From this standpoint we find that while the average length of life has doubled, the race has at the same time actually become weaker instead of stronger. This is because *personal* hygiene has not kept pace with *public* hygiene. (What is the difference between these two?)

Statistics show that this race decay is going on so rapidly that even within the last thirty years, while there has been a marked decrease in the death rate up

to forty years, there is an increase in the death rate for people over forty years of age. In Massachusetts, where the records have been most carefully kept, for persons from forty to fifty years there is an increase of 8.3 per cent; from fifty to sixty, the increase is 17.6 per cent; from eighty years and upwards, 10.1 per cent. So a man of seventy years of age to-day has only about four fifths as good a chance to live as a man of the same age had thirty or forty years ago. There is also a very great increase in the number of persons afflicted with chronic diseases.

Strange as it may seem, the condition which these figures indicate is partly the result of the increased attention given to public hygiene. The plagues and pestilences of former centuries weeded out the weak and puny individuals whose resistance was feeble, sparing the strong, healthy, and pure-blooded. The result was the survival of the fittest.

Public sanitation, quarantine laws, and hygienic measures serve a most useful purpose in preventing epidemic diseases; but this protection results in keeping alive a lot of weak persons who would otherwise be weeded out. So while the death rate is diminished and the average length of life increased, the race is weakened instead of strengthened thereby, because these feeble persons transmit their weaknesses and deficiencies to future generations.

What is to be done to check this race decay and actually to improve the race? The thing that is

needed is not less attention to public hygiene, but *more attention to personal hygiene.*

Just as it is an honor to a nation through its attention to public hygiene to have low death and sickness rates and a high average length of life, so it is an honor to an individual, by attention to personal hygiene, to keep himself in a high state of health and vitality and live a long and useful life. Let us glance at some examples of those who have attained this honor.

Some examples of longevity.

Going back to the early ages, we notice the uniformity with which men lived to advanced age. According to the ancient records, Abraham lived to 175; his son Isaac died at the age of 180; and Ishmael, his other son, at the age of 137. Jacob, the son of Isaac, lived to 147 years of age.

Pliny tells us that in the time of the Emperor Vespasian there lived in the portion of Italy between the Apennines and the Po, 134 persons who were more than one hundred years old. Of these persons three had reached the age of 140; four, 135; four, 130; two, 125; fifty-seven 110. Where could such a group be found at the present time?

The greatest authentic recorded age of our era is that of Kentigern, known by the name of St. Mungo, the founder of the Cathedral of Glasgow, who died in the year 600 at the age of 185 years. An Hungarian peasant, Pierre Zortay, is also said to have reached this great age and to have been able to walk a mile a few days before his death. His great age was attributed

to the extreme simplicity of his diet, which consisted of simple cakes of grain with milk and buttermilk.

An Englishman named Thomas Parr lived in the reigns of ten sovereigns and died in 1635, aged 152 years and 9 months. He was a poor peasant and did hard work up to the age of 130, when he is said to have threshed corn. He might have lived longer than he did, but his fame reached the ears of the Earl of Arundel, who wished to exhibit him at court. He was taken to London in a specially prepared litter and presented to Charles I. But the change of air and the change from the accustomed simplicity of his diet affected him, and he died at the Earl of Arundel's house. The king ordered the celebrated Dr. Harvey, who discovered the circulation of the blood, to make an examination of the body after death. He could find no traces of disease, but found all the internal organs in an unusually perfect state. Even the cartilages were not ossified; the rib cartilages were as elastic as those of a young man. Thomas Parr was buried in Westminster Abbey, among the great statesmen, warriors, poets, and others who have been an honor to their country, with his claim to greatness this: that he had kept his body in a perfect state of health for more than a century and a half.

The examples of great longevity are nearly all to be found in the lowly ranks of life, among peasants and laborers, persons of simple and temperate habits. Many of them have lived on a simple diet of bread, milk, and vegetables. Among the early Christians, the her-

mits who retired to the desert and lived on bread, water, and herbs, taking only the smallest quantity that would support life, lived to great age. In the list we find St. Anthony, 105 years; Arsenius, 120; St. Epiphanius, 115, and Romanul, 120.

Among other notable centenarians we have the noble Venetian, Cornaro, who lived to be nearly one hundred and who has left us a most interesting record of the reason for his remarkable freedom from all physical ills at that advanced age. He wrote this record because he was asked by so many young men to tell them his manner of life. "For when," he says, "they saw their parents and kindred snatched away in the midst of their days, and me, contrariwise, at the age of eighty-one strong and lusty, they had a great desire to know the way of my life and how I came to be so."

Luigi Cornaro, a Venetian nobleman.

Cornaro injured his health greatly in his young manhood by the excesses in eating and drinking common to men of his rank, which, he says, "caused me to fall a prey to various ailments, such as pains in the stomach, frequent pains in the side, symptoms of gout, and still worse, a low fever that was almost continuous." Before he was forty years of age he was, as he tells us, "reduced to so infirm a condition that my physicians declared there was but one remedy left for my ills — a remedy that would surely conquer them, provided I would make up my mind to apply it and persevere patiently in its use. That remedy was the temperate

and orderly life." He was given to understand by his physicians that if he wished to live he must confine his diet to light and simple foods and take these only in *small quantities*.

Cornaro loved life, he did not want to die, and he saw that his only hope lay in the change of his habits. He was evidently a man of determination of character, and realizing, he says, "that to live temperately and rationally was not only an easy matter but the duty of every man, I entered upon my new course so heartily that I never afterwards swerved from it, nor ever committed the slightest excess in any direction."

The result of this change was extraordinary : "Within a few days I began to realize that this new life suited my health excellently, and persevering in it, in less than a year I found myself entirely cured of all my complaints."

Cornaro reasoned that the manner of life that had cured him would be likely to keep him in health, and from that time he confined his diet to a very simple and meager diet, about half the quantity he had previously eaten. On this diet he reached a condition of superb health, which continued until he died at nearly one hundred years of age. This is an illustration of what we have already learned that the majority of people consume about twice as much food as they actually need, and the superfluous half is merely a tax on the system.

Cornaro experienced to the full that enjoyment of life

which results from perfect health. "The first joy," he said, "is to be of service to one's beloved country." With his restored health he was able to devote his talents to the service of his country in the patronage of the arts, in writing, building, engineering, and agriculture. He drained marshes, converting vast areas of waste lands into thriving agricultural areas, built palaces that were models of architecture, and wrote for future generations the secret of his own long, happy, useful life.

Writing when he was between eighty and ninety years of age, he gives us this picture of his life at that time: "I live in the most beautiful part of this noble and learned city of Padua, and derive from it a thousand advantages. I . . . enjoy my several gardens and always find something to delight me. . . . In April and May, as also in September and October I find other pleasures in enjoying a country seat of mine among the Euganean Hills with its fountains and gardens, and above all its commodious and beautiful abode, also my villa in the plain, which is very fine with streets and a square, and a church much honored — a country, which once deserted on account of bad air and marshy waters, is now by my labors all rich in inhabitants and fields most fertile, so that I may say with truth that in this spot I have given to God an altar, a temple, and souls to adore him. . . . Here I take pleasure with men of fine intellect, architects, painters, sculptors, musicians, and agriculturists."

Of his physical condition at this advanced age he says: "I am continually in health, and I am so nimble that I can easily get on horseback without the advantage of the ground, and sometimes I go up high stairs and hills on foot. Then I am ever cheerful, merry, and well contented, free from all troubles and troublesome thoughts, in whose places joy and peace have taken up their standing in my heart."

Mr. Edison, the great inventor, tells us that his great-great-grandfather read the life of Cornaro, and by carrying out the principles he obtained from this book, lived to the age of 102 years. Edison's great grandfather studied the same book, and lived to be 103 years old. Edison's grandfather adopted the same principles and died at the age of ninety. Edison's father followed in his daily life the example of his father, and lived ninety-four years, passing away without any apparent illness. Edison himself adopted the same principles and tells us that as a result he has been sick only four times in sixty-five years.

Leo Tolstoy, a Russian count.

Another example of splendid health and vigor in old age was Count Tolstoy, the celebrated Russian writer and social reformer. He was a lover of country life and of physical exercise. Very early in life he began to strive after perfection, physical, mental, and moral. "My only real faith at that time," he says, "was a belief in perfection. I tried to perfect myself mentally. I studied everything that I could, and that life brought

me in contact with. I tried to perfect my will, and formed rules which I tried to follow I perfected myself physically, prompting my strength and agility with all kinds of exercises and practicing endurance and patience in all kinds of privations."

In Tolstoy's boyhood he made this resolution, recorded in his diary: "I shall take exercise as much as possible, and practice gymnastics every day, so that when I am twenty-five years old I shall be stronger than Rappean. The first day I shall hold twenty pounds in my outstretched arm, the next day twenty-one pounds, the third day twenty-two pounds, and so on, until at last 160 pounds in each hand, so that I shall be stronger than anybody among the servants."

The effect of his outdoor life and muscular training was of great benefit to Tolstoy in his after life. When the Crimean War broke out he joined the Russian army and took part in the siege of Sebastopol. The rigors of the siege had no effect upon him, because of the endurance that his manner of life had developed. One of his comrades describing him at this time said that he was "an athlete who, lying upon the floor, could let a man weighing thirteen stone be placed on his hands and could lift him up by straightening his arms. In a tug of war . . . no one could beat him."

The *Tales from Sebastopol* that Tolstoy wrote at this time attracted the attention of the Czar, who issued special orders that he should be at once removed from a post of danger, as the life of so great an artist

should not be risked. Tolstoy returned to St. Petersburg, where he met dangers of another character. His writings had made him famous, fêtes and dinners were given in his honor, and he indulged for a time in excesses. He did not, however, neglect his gymnastic exercises, but spent a good deal of time in the gymnasium trying to jump over a wooden horse without touching a cone placed on its back, a favorite feat at that time.

Tolstoy soon became disgusted with the kind of life he was leading at the capital, and returned to his country estate, Nasyana Polyana, and devoted his influence, talents, and strength to trying to better the condition of the Russian peasantry. He started schools for the children on his estate and he himself did much of the teaching for a time. All the serfs owned by him were given their freedom before the laws made it necessary. He traveled in other countries to study their educational and municipal systems, visiting the universities, prisons, working men's clubs, and such institutions, in order to find out how he could best improve the condition of his own people.

Tolstoy always enjoyed manual labor. He was accustomed to mow the lawns, rake the garden beds, and even work with the peasants in the fields. He learned to make and mend shoes, so that he might have some useful manual work to do in bad weather. "For me," he said, "daily exercise and physical labor are as indispensable as air. In summer in the country

I have plenty of choice. I can plow or cut grass, but in the autumn in rainy weather it is wretched. In the country there are no sidewalks or pavements, so when it rains, I cobble and make shoes. In town, too, I am bored by simple walking, and I cannot plow or mow there, so I saw or split wood!"

It was his belief that the health and peace of mind of the peasants was largely the result of the simplicity of their life and their hard work. More and more, as he advanced in years, he departed from the life of his own class and adopted that of the peasants. He rose early and went to work in the fields. He took part in plowing, cutting the corn, and labor of that nature. He helped widows and orphans to gather in their crops.

Of the delights of plowing, Tolstoy wrote: "You cannot conceive what a satisfaction it is to plow. . . . It is not very hard work, as many people suppose; it is pure enjoyment. You go along, lifting up and properly directing the plow, and you don't notice how one, two, or three hours go by. The blood runs merrily through your veins; your head becomes clear; you don't feel the weight of your feet; and the appetite afterwards, and the sleep!"

The watchword of Tolstoy's life was *simplicity:* ". . . that is above all others the quality I desire to obtain." His habits of eating were in keeping with the general simplicity of his life. "I dine at home," he once wrote, "on cabbage soup and buckwheat porridge, with which I am contented." Later in life

he gave up meat eating because he became convinced that it was not the natural diet, and that the moral effect of the unnecessary taking of life must be harmful. For the same reason he put away his gun and ceased to engage in field sports.

Another indulgence which Tolstoy also renounced as injurious and unhealthy was tobacco. "The man who does not smoke," he said, "saves ten years of his life, and the man who does not drink saves twenty." Writing to a friend he said, "Do you still smoke? I do not know how to rejoice sufficiently at having rid myself of this habit." In his old age, as in his youth, he was still striving after perfection, resolutely giving up every habit that he saw to be a hindrance to him.

William Ewart Gladstone, an English statesman.

Late in life, Mr. Gladstone was given the popular nickname, "Grand Old Man," because of his great vitality and physical vigor in old age. He was Premier of Great Britain and Ireland at the advanced age of eighty-four years.

Mr. Gladstone was first elected to Parliament when a young man only twenty-three years of age, and his parliamentary career lasted for more than sixty years. He was the greatest orator of his age, and in his prime he could be heard without difficulty by an audience of 20,000 people. One who heard him often said: "After the delivery of a speech of four or five hours in its duration, the closing words will ring as a bell upon the ear, without the faintest

perception to the last of anything like physical exhaustion."

Describing him when he was over seventy years old, another said: "The intellectual fire is rather quickened than quenched, and the promise of health has been abundantly fulfilled in a maintenance of physical strength and activity that seems phenomenal. Mr. Gladstone will outsit the youngest member of the House if the issue at stake claims his vote in the pending division. He can speak for three hours at a stretch, and he will put in the three hours as much mental and physical energy as would suffice for the whole debate. His magnificent voice is as true in tone and as insensible to fatigue as when it was first heard within the walls of the house." Even when eighty-six years of age he said, "What difference does it make to me whether I speak to four hundred people or four thousand?"

On the eve of his seventieth birthday, Mr. Gladstone started out on a political campaign in the midst of a severe winter. Day after day, sometimes twice or three times a day, he addressed large audiences, often in the open air. "Speech followed speech, none a repetition of the other, and all the world agreed that never in history had there been an equal display of physical and intellectual force from a man whose years were threescore and ten."

Being asked the secret of his wonderful vitality, Mr. Gladstone answered: "There was a road leading out

of London on which more horses died than on any other. Inquiry revealed the fact that it was perfectly level. Consequently the animals in traveling over it used only one set of muscles."

Mr. Gladstone preserved his mental and physical health by varying his intellectual work and by vigorous physical exercise. Besides the immense amount of work which his political career made necessary, he wrote many books and pamphlets, the naming of which takes up twenty-two pages in the catalogue of the British Museum.

His ability to accomplish so much was attributed by him to his marvelous faculty for concentration, which he said was the only thing in which he differed from other men. He concentrated all his forces on whatever he chanced to be doing at the moment and threw his whole soul into it.

Once in addressing a gathering of schoolboys he told them that if a boy ran he should run as fast as he could; if he jumped, he should jump as far as he could. Following this advice would certainly result in increased capacity to run and jump. Mr. Gladstone followed this principle in his own career. He never did anything by halves, but exerted his powers to the utmost and, in this way, increased his capacity.

Mr. Gladstone's favorite recreation and hobby was felling trees. Stripped to his shirt, he often attacked the tough oaks on his estate at Hawarden and sometimes felled a four-foot forest monarch in a day. He

was also a great walker, going very fast and very far, as we should expect of such a man.

We may presume that he himself followed the famous rule given to his children, to chew every mouthful of food thirty-two times. We suppose, too, that this thorough mastication had much to do with keeping him in health until nearly ninety years of age. A person who once watched him closely at a banquet declared that he counted his chewing movements and found that he exceeded his rule, often chewing each morsel forty times or more.

Captain Diamond, athlete at 114 years of age.

One of the most remarkable men of this country in recent years, from the physical standpoint, was Captain Ezekiel Diamond, who at the age of 100 years was an active athlete, writer, and teacher of physical culture. One who visited him at the age of 114 years says that he was "able to lift his foot with ease to the top of his five-foot bookcase, read ordinary type at the proper distance of fourteen inches without glasses, and get up and down stairs like a man of forty."

Like Cornaro, Captain Diamond has written a book in which he tells us what he believes to be "the secret of a much longer life, and more pleasure in living it."

His boyhood was spent in pioneer farm life, and "it is quite probable," he says, "that I owe much of my lifelong health to the simple industrious habits, swinging the axe, digging with the hoe, mixing with the earth, and breathing the pure air." Having no

trade and no education, he afterwards lived a migratory life, spending his summers in the north helping to build the first railroads in the United States, and his winters in the south in the commission business or superintending plantations. He also took part in the construction of canals, and levees, and made occasional trips to the West Indies and to Europe. Sixty-five years of his life, more than the average span, were spent in this way.

Later on he went west, arriving in San Francisco as an emigrant. For years he operated a street car in that city. In his ninety-seventh year he took a position as night watchman in a hotel. After he was one hundred years old he began selling books, his own among the number, walking from ten to twenty-five miles a day. But the fire connected with the San Francisco earthquake in 1906 destroyed 17,000 copies of his book and sent him at the age of 110 as a refugee to Oakland, where he slept in a church pew. From there he moved to a loft, into which he had to climb by means of a vertical ladder.

Captain Diamond tells us in his book what he believes has made this long life of labor possible. It is not a case of inheritance, neither is it accidental, but "is the result of a life of denial to the palate, and of good care to the framework of the body."

When he was over sixty years old he suddenly, to his surprise, found himself to be getting old. He discovered it, he says, in this way:

"One day I jumped from a wagon to the ground, and my joints did not respond with the usual rebound. I was startled and surprised. Resuming my place in the wagon I leaped to the ground again as a proof trial. The proof was there, for not only did the knees refuse to rebound but the backbone creaked and cried out in pain. I was humiliated."

From this time Captain Diamond began to give special care to the body, not because he wanted to live to be old, but because he wanted "to enjoy life as long as it lasted." "Three things," he says in his book, "I have faithfully practiced for the past half century. The first is that of breathing the freshest air possible, long, deep draughts. The second is the selection and eating of the best bone and blood food at my command. The third is the use of pure water at proper time and temperature, never taking it ice cold."

Cornaro laid the chief emphasis upon limiting the quantity of the food. Captain Diamond lays more upon the selection of the food:

"The selection of the food and drink is of vast importance in youth, but it does not become of first importance in the estimation of men until they have reached the meridian of life. By this time the machinery of the physical man has been running several decades with but little attention, and there is rheumatism, chronic headache, liver pains, kidney troubles, stomach rebellions, dyspepsia, which means chronic

constipation. It is generally known and admitted by the most thoughtful people that by far the greater amount of physical suffering is the result of eating too much or of eating the wrong kind of food."

"When I began to prepare the body for long and healthy life, I left out of my diet slaughtered meats. Strong meats, often taken, are the source of all kinds of disease, laying the foundation for untold suffering."

Captain Diamond gives us the following sample of his dinner menus:

"Hot water, vegetable or rice and tomato soup, whole wheat bread, buttered or with olive oil, sweet potatoes, beans, fruit in season."

He had great faith in olive oil, not only as a food but he frequently anointed his body with it.

In dedicating a revised edition of his book he says:

"After more than 110 years of active life, in possession and perfect use of every sense and faculty unimpaired, I dedicate this book to the cause of temperance in all things, knowing that proper care of the body, and selection and use of Nature's food and drink, are the only means of arriving at old age healthy and happy."

President Eliot's testimony.

Dr. Eliot, for forty years president of Harvard University, was asked a few years ago to make known for the benefit of the public the secret of the marvelous vigor and activity of mind and body that he has maintained in spite of the duties of his exacting position. This is his reply:

"My health and capacity for work at seventy-seven

years of age are unusually good. I attribute this result to a good constitution, moderation in eating and drinking, a habit of taking some exercise and some fresh air every day, and of avoiding all sorts of luxury and the constant use of any drug, such as alcohol, coffee, tea, or tobacco.

"Since I was twelve years of age my sports have been walking, riding horseback, driving, rowing, and sailing; to which, after I was sixty-five years old, I added riding a bicycle. I am still good for all those sports in moderation, and still enjoy them.

"The use of dumb-bells and clubs has been for me only an inferior resort in bad weather, or when I am somewhat prevented from getting my exercise in the open air. Under such circumstances I still use light dumb-bells.

"In 1858, when I was a tutor in Harvard College, I rowed in the Harvard boat (the first shell) in two regattas on the Charles River basin, in both cases for money prizes, the Harvard boat winning against a large number of competitors. The performance only lasted about two months, and was the only exception to the rule that the sports which have served and still serve me are individualistic, requiring no team or group of coöperating players. Individualistic sports can be carried on into middle life and old age at great advantage over sports which require the coöperation of other persons.

"Ever since I can remember I have been disposed to

do every day all the mental work I could perform without fatigue, and that is still my practice — a wholesome one.

"When I am asked about the habits which are most conducive to a long, active life, I generally answer, 'Moderation in eating, a full allowance of sleep, and no regular use of any stimulant whatever!'"

Health Problems

1. From the reports of the health office in your city or county, find out what per cent of the deaths in your community result from the diseases mentioned in this chapter as needless.

2. Do you know any people over ninety years of age who are still active and healthy? If so, find out what they have done to preserve their health.

3. What kind of diet seems best suited to make one long-lived?

4. Do many people who have used tobacco and alcohol the greater part of their lives live to a useful old age? Why?

5. If you can do so, find out something about the oldest inmates of the poorhouse in your community. See if you can tell what habits or conditions of life caused them to become too feeble to work in their old age.

6. In the little state of Sparta, old men who were still active and strong were treated with honor and respect. Do you think this was just? Why?

7. Few of the men mentioned in this chapter were wealthy. Most of them were hard workers. Explain.

8. Find out in what trades or what kind of positions there are the greatest number of vigorous old people. Explain.

9. Do you know people who worked in mines or factories in early childhood and who are healthy in old age?

10. Mention some games you can play in winter which will help to make you strong and long-lived. Mention some you can play in summer.

Review Questions

1. What was the average length of human life in the sixteenth century?
2. What is the average length to-day?
3. Do men now live to a greater age than in the past?
4. What has caused the increase in the *average* length of life?
5. What is the average in India? In Sweden? Why is there such a difference?
6. Upon what does the *average* length of life depend?
7. What is a plague? Mention some plagues.
8. Tell how plagues of various kinds are being prevented.
9. What per cent of the deaths occurring annually in this country are needless?
10. Name the preventable diseases that are causing many deaths.
11. What is the true measure of a nation's vigor? Why?
12. Is the race as a whole becoming weaker or stronger? How do we know this?
13. How has the increased attention given to public hygiene helped to make the race as a whole weaker?
14. What is needed to strengthen the race?
15. Give some examples of longevity in early times.
16. Tell about Thomas Parr. To what was his longevity due?
17. How did Cornara transform himself from a weak, sickly man to a strong, healthy, long-lived one?
18. What did Tolstoy strive for? Tell how he attained great physical perfection.
19. What did Tolstoy say about the effects of tobacco?
20. What did Gladstone observe about the horses that traveled a certain London road?
21. Tell how he applied this to his own life.
22. Tell about Captain Diamond. What did he recommend for people who wished to lead a long and useful life?
23. To what three things does President Eliot attribute his strength and long life?

REMEMBER

That which upbuilds the body and increases efficiency

Exercise	Rest and sleep
Pure air	Sunlight
Good food	Good health habits
Pure water	Purposeful work

Cheerfulness

Natural defenders of the body

Liver cells

Body glands

Digestive fluids

White blood cells

Respiratory tract

That which tears down and injures the body

Impure air	Wrong habits of living
Bad food	Unnatural clothing
Impure water	Drugs and patent medicines
Germs	Stimulants and narcotics
Anger	Fear

CHAPTER XV

"Safety First"

On street cars and in other places one sometimes sees a big red dot with the words, "Safety First." The purpose for this slogan is protection against accident. It is placed at especially dangerous places as a warning against accidents. Safety first means, "look out for danger," "be careful," — careful to keep one's self out of harm's way and careful that no harm shall result to others, through carelessness. This simple warning has been the means of saving many from death and accident.

We are constantly surrounded by invisible foes to life and health. A soldier on the battlefield is liable at any time to be hit by a bullet or a bursting shell and to be fatally wounded. Bullets fly so swiftly the soldier can not see them, but he can hear them whistle through the air and perhaps can see the smoke of the gun which fired them. Enemies of life quite as dangerous as bullets are constantly flying about us. They attack us on every hand; we can never wholly escape them, so we must know how to avoid them as much as possible and how to defend ourselves against them.

Let us consider some of the ways in which we may be

attacked by the germs which cause disease and the best means of applying the principles of "safety first" in case of those diseases generally known as "communicable" or "catching." In each case the real cause of the illness is a germ or microöganism peculiar to the disease itself, which in various ways is passed around.

It is most important to avoid disease. Not only are germ diseases a danger in themselves, but they break down vital resistance and thus open the gates for other serious maladies to get in. Influenza is often followed by pneumonia or tuberculosis, measles by impairment of sight and hearing, typhoid by tuberculosis, and diphtheria by paralysis and heart troubles.

Most of these diseases are spread by actual contact with the sick or by contact with the things the sick have used, thus providing a carriage of the germs that cause the disease into the mouth or nose of the well person.

It would be easier to avoid contagion if one always knew just where it would meet him. As this is not possible, it is important to be on guard at every point where it is to be expected.

Every child can apply the following "Safety First" rules:

"Safety First" rules for health.

(1) *Keep the hands clean.* Wash them very often. Cleanliness of the hands is one very important protection against diseases that can be communicated from one person to another. In certain French and English hospitals tests were made. Persons ill with different communicable

diseases were cared for in the same wards with persons who did not have the disease, the greatest precaution being taken by every one caring for the sick to wash the hands after touching any patient, and allowing no object which had touched the sick one to touch another until it had been cleansed. There was no spread of diseases in any case where this rule was strictly observed.

For one thing this proved that cleanliness of the hands is one of the greatest safeguards against communicable disease. It is very probable that dirty hands cause more disease than any other agent.

The man who milks with dirty hands, the cook who does not cleanse her hands thoroughly before touching the meal, may each be the cause of disease to those who partake of the food. Many babies get the germs of dysentery and diarrhea from the unclean hands of those who care for them.

The germs which cause tuberculosis are found on the hands of most persons suffering with that disease who have not trained themselves to the utmost carefulness in keeping the hands clean. The germs of other communicable diseases likewise pass from the mouth to the hands and are readily conveyed from one to another in numberless ways. Name as many such as you can.

It is to be hoped that at your school you have soap fountains and running water to aid you in keeping clean hands. You will of course bring your own towel and nail brush and soap if none is supplied. Remember, also, to avoid putting the fingers in the mouth.

(2) *"Put nothing into the mouth except food."* You have already learned many reasons why this is so important. It is an unsafe habit to use the mouth to hold coin, pins, pencils, tickets, and the dozen other similar things which people put there to retain just a moment. One runs the risk of getting some deadly disease each time it is done. The germs of every sort of communicable disease are easily carried on these articles that frequently pass from hand to hand.

(3) *Keep the teeth clean and free from decay.* Teeth in good condition are a great safeguard against dangerous disease. An institution in an Eastern city which cares for three hundred orphan children had each year, for a considerable period, some seventy or eighty cases of communicable disease. A dental clinic was established and thereafter for three years the rate was only three cases per year.

(4) *Keep entirely away from persons having a disease of communicable character.* Run no risks. Children ought not purposely to expose themselves to disease. The idea many people have that it is the lot of every child, sooner or later, to have measles, scarlet fever, chicken pox, and whooping cough, and that it is well to "have it over with" is a mistaken one. Children should be most carefully protected from these diseases in their early years. Bad enough at any period of life, they are far more fatal to children under ten years of age.

(5) *Beware of any one who has a sore throat.* Sore

throat is a common symptom of diphtheria, septic sore throat, scarlet fever, measles, and whooping cough. One may have sore throat and yet have none of these diseases, but precaution is always wisest. It is dangerous to kiss a person with a sore throat, to drink from the same cup, to use the same napkin or spoon, take a bite from his apple or candy, or put his pencil in your mouth, or to handle his books or toys.

(6) *Court cleanliness in all things.* If one would escape the typhoid germs, he must drink only water that is pure and clean. If there is any doubt about the water, boil it. Use none but clean milk. Certified milk is safest. Tuberculosis, typhoid fever, scarlet fever, measles, diphtheria, meningitis, dysentery, smallpox may each be conveyed by dirty milk. Lacking surety about the milk supply, it is wisest to boil or pasteurize it. Cleanse raw foods thoroughly before eating. Keep all foods away from dust and flies. Flies carry typhoid, tuberculosis, and other disease germs both inside their bodies and on their feet. Flies are dangerous and should be destroyed together with mosquitoes, cockroaches, and other household pests.

Keep the premises clean and the house and schoolhouse free from dust. Dirt does not produce disease germs, but it harbors them. Pneumonia, tuberculosis, and influenza germs are commonly found in dust.

(7) *Breathe pure air.* Get it out of doors just as much as you can. Work, study, play, and sleep in the open

air. Make ample provision for fresh air indoors, by opening the windows. Breathe through the nose and not through the mouth.

(8) *Dwell in the light.* Sunlight destroys disease germs. It aids all the vital functions. Keep in the sunlight as much as possible, especially in the winter season.

(9) *Do everything you can to build up a strong body and vigorous health. This will aid you most of all to withstand the germs that cause disease.*

(10) *In case the indications of illness do not disappear quickly, the parents and the family physician should be consulted.*

General directions.

When it is known that a communicable disease exists, we can take pains to protect ourselves from it, but the danger from the sick we never see is often far greater. The baker who makes our bread or some person who handles it, if sick or dwelling with the sick, may, if careless, be the agent through which disease is brought to us. Many people are ignorant of the dangers from communicable disease; many others, although knowing, are not painstaking. So it may happen that the welfare of every citizen is threatened each time a case of such a disease occurs in a town. Because they recognize that health is the right of every individual and the need of protecting their citizens, many communities maintain a Health Department or a health officer to aid in controlling the common ways by which disease is spread.

Such a measure stands for the welfare of every citizen and should have his support and coöperation.

When a case of illness is suspected of being of a communicable character, it is the work of the health department or officer to investigate it. If it be found to be a case of dangerous disease, the sick person must be separated from those who are well, and kept apart until he will not communicate the germ of the disease to others. The length of this time depends upon the patient's condition and not upon any set rules; for example:

The only way to know whether a case of sore throat is really diphtheria is to find the diphtheria germ in a culture taken from the patient's throat. The only certain way to tell that the person has recovered so that he will not infect others is by an examination of specimens from his throat on two different days showing that there are no longer diphtheria germs there. The patient may feel well long before this, and still the germs may be present and may be communicated to other people. The well-informed health officer can best determine just when, in case of any catching disease, the patient may be safely released from quarantine. It is part of his work to do this and to see that the patient's home and belongings are properly disinfected after the illness. This is most important, as the germs which cause some communicable diseases keep alive for a long time, even years, in some instances. A schoolroom, railway coach, and other public places in

which germs of contagious diseases have been scattered are unsafe until they have been disinfected.

The law in most places demands that immediate notice of every case of communicable disease be given to the health officer. It is then his duty to place a card upon the dwelling warning the public. The people in a house so marked are placed under what is called quarantine. Until this quarantine is lifted, they are not permitted to leave the house, or the place under quarantine. This is a safety measure in which every one should be willing to coöperate.

Persons known to have been exposed to communicable disease ought, for the sake of other people's safety, to keep away from school, the playground, church, and all public places until all danger of having the disease is past.

When a case of communicable disease occurs it is well for us to know that for the safety of both the sick one and those who care for him, the sick room should be cleared of all needless articles, clothing, bric-a-brac, and everything likely to harbor germs. Provision should be made for an abundance of fresh air. Pets should never be allowed to visit the sick room. Food and drink that are left over from the sick room should always be disinfected or burned — never put into the garbage can. Eating utensils, playthings, soiled clothing, bedding, in fact everything that is used in the sick room, *must be disinfected thoroughly before being taken from the room.* In particular the discharge from the nose, mouth, eyes, ears, throat, and lungs should be received

on old cloths or paper napkins and *immediately burned*, and all other discharges from the body should *be at once disinfected.*

In both pneumonia and tuberculosis the sputa (all discharges from the lungs, throat, nose, and mouth) contain the germs by which these maladies are usually spread. It will be plain, then, why this dangerous matter should be destroyed. During an illness of penumonia or tuberculosis great care should be taken to prevent the soiling of bedding, clothing, and carpets with sputa. The patient should cough into a moistened cloth which should be burned before it becomes dry. This precaution should be continued even after the pneumonia patient is able to be about, just so long as anything is raised from lungs and throat.

Tuberculosis is doubtless the most common of all these dread diseases, but fortunately it is one of the most easily cured in its early stages. Many people know very little about this disease and contract it because they are not aware of the ways in which it can be prevented. From a State Board of Health we get the following rules which every person will be wise to learn:

Rules of health in tuberculosis.

The person infected with tuberculosis should protect himself, his family, his associates, and the public by not spitting in public places, and by promptly destroying all discharges.

Flies carry sputum and its infection to food, to your hands, your face, clothes, the baby's bottle, from which the germs are taken into

the mouth and thus gain access to the stomach and lungs.

Spitting on the sidewalk, on the floor, on the wall, on the grass, in the gutter, or even into a cuspidor containing no disinfectant is a very dangerous practice for a consumptive to indulge in.

The well person should defend himself by insisting that the tuberculous patient shall destroy all discharges.

Well persons should set the example of restraint and themselves refrain from spitting promiscuously.

A person may appear quite healthy, and yet be developing tuberculosis without knowing it.

Such a person, if he spit where he pleases, may be depositing infected sputum where it can endanger the health and lives of other persons.

Do not sleep with a person who has tuberculosis, nor in the room occupied by a tuberculous person, until that room has been thoroughly disinfected.

Any person is liable to contract tuberculosis, whether he is well or not.

Sickly persons, or those having bad colds, influenza, bronchitis, pneumonia, or any general weakness are much more liable to contract tuberculosis than a perfectly well or robust person.

If you have a cough that hangs on, consult at once a reliable physician who has ability to diagnose tuberculosis.

Prevention is possible; it is cheaper and easier than cure.

We have seen how we are in danger of contagion from persons who are sick; from articles they have used; places they have been in, and careless people who may have cared for them or visited their sick room. There are also many persons who do not feel at all sick themselves who have the germs of diphtheria and typhoid in their bodies and may convey them to others. These persons are termed carriers. One such who carries diphtheria germs going to a school may give the germs to every pupil in the room. Not long ago an epidemic of diphtheria broke out in a little town of six thousand people. Upon investigation as to the cause there were found four hundred individuals who were carriers of the disease none of whom felt ill or even suspected they had the germs.

It is often remarked that epidemics of diphtheria, measles, whooping cough, and other communicable diseases more commonly occur at the beginning of the school year or directly after vacation than at any other time. Do you not think that if every school had a health officer or inspector to examine the pupils upon entrance, make tests for carriers, examine and care for the teeth, and give attention to other health measures, it would be an excellent and wise plan?

GLOSSARY

KEY TO PRONUNCIATION

ā, as in **āle**; **ȧ**, as in **sen′ȧte**; **â**, as in **câre**; **ă**, as in **ăm**; **ä**, as in **ärm**; **ȧ**, as in **ȧsk**; *a*, as in fi′n*a*l; **ē**, as in **ēve**; **ė**, as in **ė-vent′**; **ĕ**, as in **ĕnd**; **ẽ**, as in **fẽrn**; *e*, as in re′c*e*nt; **ī**, as in **īce**; **ỉ**, as in **ỉ-de′a**; **ĭ**, as in **ĭll**; **ō**, as in **ōld**; **ȯ**, as in **ȯ-bey′**; **ô**, as in **ôrb**; **ŏ**, as in **ŏdd**; **ū**, as in **ūse**; **ů**, as in **ů-nite′**; **ŭ**, as in **ŭp**; **û**, as in **ûrn**; **y̆**, as in **pit′y̆**; **o͞o**, as in **fo͞od**; **o͝o**, as in **fo͝ot**; **ou**, as in **out**; **oi**, as in **oil**.

A

abstinence (ăb′stĭ-n*e*ns). The act, or practice, of denying one's self, particularly as applied to drinking alcoholic beverages and to smoking.

acetanilid (ăs′ĕt-ăn′ĭ-lĭd or lĭd). A medicinal compound of aniline with acetyl, used to relieve fever or pain, but dangerous when used without a physician's order.

anæmia (ȧ-nē′mĭ-ȧ). An unhealthy condition of the blood, in which there is too little blood in the body or in which the blood itself is lacking in some essential quality.

antipyrin (ăn′tĭ-pī′rĭn). A medicine containing an alkaloid, used to relieve fever.

antiseptic (ăn′tĭ-sĕp′tĭc). Anything, usually a liquid, that prevents decay or that protects one from germs.

aorta (ȧ-ôr′tȧ). The great artery which carries the blood from the heart to all parts of the body except to the lungs; the main trunk of the arterial system.

arterioles (är-tē′rĭ-ōlz). Very small arteries.

arterio-sclerosis (är-tē′rĭ-ō sklė-rō′sĭs). The hardening of the arteries, due usually to bad habits of living in respect to eating, drinking, and smoking.

B

bacillus (ba-sil′us). A tiny vegetable organism often the cause of disease; often spoken of as bacteria.

bile (bīl). A yellow, or greenish, fluid manufactured by the liver and necessary for the digestion of fats.

bismuth (bĭz′mŭth). A substance sometimes used in experiments of tracing the passage of food along the alimentary canal.

C

caffeinē (kaf-fēn′). A white, bitter substance in coffee; a poison.
calorie (kăl′ō-ri). A unit of heat. Just as in measuring a straight line, we begin with the inch, so in measuring heat, we begin with the calorie.
calorimeter (kăl′ō-rĭm′ē-tẽr). An apparatus for measuring the number of calories of heat in anything.
cartilage (kär′tĭ-lāj). An elastic tissue, through which the light passes but through which objects can not be seen; gristle.
cellulose (sĕl′ū-lōs). An indigestible substance found in most fruits and especially in vegetables.
centenarian (sĕn′tē-nā′rĭ-*a*n). A person one hundred years old or more.
centigrade (sĕn′tĭ-grād). Consisting of one hundred degrees — used to describe a thermometer on which the freezing point of water is 0° and the boiling point is 100°.
cerebrum (sĕr′ē-brŭm). The large division of the brain. It controls the reason and the will.
chronic (krŏn′ĭk). Continuing for a long time; lingering; habitual.
circular muscles (ser′ku-lar mŭs″les). The muscles that go *around* an organ or an opening.
cocaine (kō′kȧ-ĭn). A substance used to deaden pain; a poison.
coma (kō′mȧ). A state of unconsciousness from which it is difficult or impossible to arouse a person.
convolutions (kŏn′vō-lū′shŭnz). Irregular, wave-like foldings of an organ; as, the convolutions of the intestines and of the brain.
corpulence (kôr′pū-l*e*ns). Excessive amount of fat, fleshiness.
cortex (kôr′tĕks). An outer covering, as the cortex of the brain composed of the outer layers of nerve cells.

dietary (dī′ĕt-ā-rȳ). Rules of diet; that is, of the amount and kind of food to eat.
dynamometer (dī′nȧ-mŏm′ē-tẽr or dĭn′ȧ). An apparatus for measuring force or power, used to test the power of the muscles.

endurance (ĕn-dūr′*a*ns). The quality of being able to keep up an exertion or to bear pain, for a considerable length of time.
ergograph (ẽr′gō-grȧf). An instrument for registering the amount of work performed by a contracting muscle up to the point of fatigue.
excrete (ĕks-krēt′). To cast off from the body as useless.
extensors (ĕks-tĕn′sŏrz). Muscles that serve to extend or straighten any part of the body, as an arm or a finger; — opposed to flexors, which bend or contract muscles.

fatty degeneration (făt'ty dē-jĕn'ẽr-ā'shŭn). A diseased condition, in which the presence of too much fat interferes with the working of the organs.
fermentation (fẽr'mĕn-tā'shŭn). The change in a substance to a bubbling state, or state where the presence of gas causes the substance to be in motion. A change in a substance due to the action of bacteria. Usually gas is formed, and also alcohol in greater or less quantities.
fibroid degeneration (fī'broid dī-jĕn'ẽr-ā'shŭn). A form of decline in which organs or tissues are changed into tissue made up of fibers.
fissures (fĭsh'urz). The furrows or depressions in the surface of the brain.
flexors (flĕks'ŏrz). Muscles which bend (flex) any part; — opposed to *extensors*.
frontal lobes (frŏn'tal lōbz). The round projecting parts of the brain in front of the inside of the skull.

G

glycogen (glī'kō-jĕn). A substance like starch; "animal starch."

H

hemoglobin (hĕm'ō-glō'bin or hē'mō-glō-bĭn). The coloring matter of the red blood corpuscles.

I

incapacitated (ĭn'kȧ-păs'ĭ-tāt-ĕd). Deprived of natural power; disabled.
infection (ĭn-fĕk'shŭn). Disease caused by germs; also the giving of disease germs to a well person by a diseased one.
insomnia (ĭn-sŏm'nĭ-ȧ). Inability to sleep; wakefulness; sleeplessness.

J

Jiu Jitsu (jū'jĭt's'). A Japanese system of training for physical contests like wrestling.

K

kilogram (kĭl'ō-grăm). A measure of weight in the metric system, equal to about two and one fifth pounds in our system.

L

longitudinal muscles (lŏn'jĭ-tū'dĭ-nal mŭs''les). Muscles that extend lengthwise with the organ which they govern.

M

massage (măs'sȧj; F. mȧ'sazh'). A rubbing of the body, done especially as a hygienic or remedial measure.

medulla oblongata (mē̇-dŭl′lȧ ŏb′lŏn-gā′tȧ). The back part of the brain connected with the spinal cord.

metabolism (mē̇-tăb′ō̇-lĭz′m). The process by which living tissues take up and change the material that the blood brings them for nourishment or by which they change their own substance into matter that can be thrown out of the body.

micron (mī′krŏn or mī′krŏn). A measure of length in the metric system; about one twenty-five thousandth part of an inch in our system.

morphine (môr′-fĭn or fēn). A drug, opium, which deadens pain and puts a person to sleep, but which is dangerous.

N

nicotine (nĭk′ō̇-tĭn or -tēn). An element found in tobacco. It is very poisonous.

nitrogen (nī′trō̇-jĕn). A chemical which may be in the form of gas in the air, or in the form of liquid.

O

occipital lobes (ŏk-sĭp′ĭ-t*a*l lōbz). The round projecting parts of the brain at the back of the inside of the skull.

opium (ō′pĭ-ŭm). The juice of the poppy plant. The Chinese used to smoke it.

opsonic index (ŏp-sŏn′ĭk ĭn′dĕx). A statement of the condition of one's blood in respect to its power to destroy a particular disease germ, as the tuberculosis germ.

P

parasite (păr′ȧ-sīt). A plant or animal that lives on another, drawing the juices or nourishment of the other and doing no independent work.

parietal lobes (pȧ-rī′ē̇-t*a*l lōbz). The round projecting parts of the brain at the sides of the skull.

pelvis (pĕl′vĭs). That part of the body below the stomach, which contains the pelvic bones.

pestilence (pĕs′tĭ-l*e*ns). The plague, or any terrible fatal disease that spreads easily, rapidly, and widely.

phenacetin (fē̇-năs′e-tĭn). A substance used in medicine to relieve fever but dangerous if used without a physician's order.

physique (fĭ-zēk′). The physical build or structure of a person; physical appearance.

plague (plāg). An acute contagious fever, incurable and terrible in its attacks; any disease that destroys many people in a short space of time.

plethysmograph (plĕth′ĭs-mō̇-grȧf). An instrument for determining and registering the variations in the amount of blood in an organ or member of the body, as the arm.

plumb line (plŭm līn). A straight line between two points, as between the forehead and the floor.
proteid (prō'tē-ĭd). One of the elements present in greater or less degree in nearly all plants and to a large degree in animal tissues and organs.
ptomaines (tō'mȧ-ĭnz or ēn). A class of substances that grow in dead matter; poisons.
pulmonary circulation (pŭl'mō-nā'ry sẽr'kū-lā'shŭn). The system of circulation in the body that goes through the heart and the lungs.
pulse (pŭls). The beating of the heart or blood vessels, especially of the arteries at the wrist and in the temple.
putrefaction (pū'trē-făk'shŭn). The act of rotting, of decaying.

S

secrete (sē-krēt'). To extract from the blood and make into a new substance, as the salivary glands secrete saliva.
sedentary (*sĕd'ĕn-tā-rў*). *Accustomed to sit much or long without exercise, or requiring much or long sitting.*
sphygmomanometer (sfĭg'mō-mă-nŏm'ē-tẽr). An instrument for measuring pressure of blood in an artery.
sphygmograph (sfĭg'mō-grȧf). An instrument by which the pulse may be made to write a record of its own action.
spirometer (spī-rŏm'ē-tẽr). An instrument for measuring the vital capacity of the lungs; that is, the volume of air which can be expelled from the chest after the deepest possible taking in of breath.
sputum (spū'tŭm). Saliva; what is expectorated; spittle.
sternum (stẽr'nŭm). The breast-bone.
symmetry (sĭm'mē-trў). Correct proportion or balance of the parts of the body.

T

tannin (tăn'nĭn). A harmful acid in tea.
temporal lobes (tĕm'pō-ral lōbz). The round projecting parts of the brain at both sides of the skull.
theine (thē'ĭn or -ēn). A poison found in tea and coffee.
toxin (tŏks'ĭn). A poison, referring often to the poisons developed within the body.

V

vasomotor center (văs'ō-mō'tẽr sĕn'tẽr). A nerve center concerned with the regulation of the distribution of the blood, by acting on the muscular coats of the blood vessels.
vertebræ (vẽr'tē-brē). (Plural of vertebra). The small bones that make up the backbone.

INDEX

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